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This study was concerned with the optimum allocation of public resources in education, and involved a comparison between vocational-technical education and an alternative curriculum for non-college attending students. Major steps in the study were: (1) identification of costs and benefits, (2) collection of representative data, (3) determination of appropriate criteria for investment decisions, (4) statistical analysis, (5) calculation of the return to the investment, and (6) consideration of limitations and related issues. Data were collected in three cities. The dependent variables were the average monthly earnings before and after taxes 1 and 6-years after graduation, and the percent of time employed 1 and 6-years after graduation. The independent variables were (1) city of graduation, (2) type of curriculum, (3) sex, (4) IQ, (5) race, (6) marital status, and (7) father's education. Other non-monetary and non-economic benefits and performance characteristics such as voting behavior and economic aspirations were also examined. A detailed discussion of conceptual, statistical, and methodological considerations is included, in addition to an extensive discussion of specific findings. (EM)

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A COST-EFFECTIVENESS STUDY OF VOCATIONAL EDUCATION

A COMPARISON OF VOCATIONAL AND NONVOCATIONAL EDUCATION IN SECONDARY SCHOOLS

March 1969

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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PREFACE

In conversations with officials of the U.S. Bureau of the Budget, and after the submission of a preliminary report on the cost-effectiveness of vocational education, the investigators in this study were asked: "Should the United States invest more money in vocational education, given alternative investment opportunities in other educational curricula?"

This question is one which confronts decision-makers at all levels of government. To answer this question it is necessary, first, to develop the appropriate theoretical framework and, second, to obtain data which are relevant to this framework. These are the two fundamental objectives of this report.

The U.S. Office of Education provided the funds for this study. Although the usual disclaimer appears on the title page, as required by the contract, it should be asserted, without qualification, that the investigators had a free hand in the conduct of the study.

A study of this type requires the cooperation of many persons, particularly in the collection and organization of the basic data. They include school administrators and their assistants, interviewers, clerks, and secretaries. The investigators are most appreciative of their efforts.

Persons who assisted in the organization and analysis of the data include: Timothy Curry, Ronald Hamill, Mary Ellen Thompsen, Priscilla Yeh, and Norman Kalber. Without the assistance of these persons the analysis, for which the investigators are responsible, would not have been possible.

Criticisms and suggestions were solicited from Professor Mary Jean Bowman of the University of Chicago on the basis of a preliminary report which was submitted to the U.S. Office of Education in October

1967. The investigators are most appreciative of her sharp and penetrating observations. Needless to say, she is in no way to be held responsible for the analytical framework, the analysis, or conclusions set forth in this third report.

The investigators in this study have attempted to contribute to the development of some significant advances in the theoretical and empirical aspects of the application of cost-effectiveness techniques to vocational education in particular, and to education in general. It is their hope that some scholars will study this report and utilize it as a basis for improving the theoretical aspects of this technique and that others will attempt to apply it to their particular areas of interest.

Jacob J. Kaufman
Project Director

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INTRODUCTION: THE OBJECTIVES OF THE STUDY

On October 16, 1968, the President of the United States signed into law the Vocational Education Amendments of 1968 which, among other things, provided for the authorization of increased expenditures for vocational education through the fiscal year 1972-1973 and pointed toward new directions for vocational education. These new directions reflected, in part, certain changes recommended by the Advisory Council on Vocational Education which, under the requirements of the Vocational Education Act of 1963, had the responsibility to review and evaluate current national vocational and technical education programs.[1]

A. Inadequacy of Current Evaluation Techniques

When vocational education was discussed in a Report of the Panel of Consultants in 1963 it was noted that a "*Lack of data and tangible evidence* ... make it difficult for laymen and professionals to fully evaluate the vocational program of vocational education." (Emphasis in original.) It stated, in addition, that "Objectives and standards are quite valueless if, as criteria of appraisal, they cannot be compared with the data that indicate whether, or how efficiently, purposes are being achieved." (Emphasis added.)[2] This 1963 report stated further that "Research of an evaluative type, which is fundamental to sound development, has been also very limited. Little or no evidence has been gathered regarding the results or effectiveness of the instruction given ...."[3]

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[1] *Notes and Working Papers Concerning the Administration of Programs*, authorized under the Vocational Education Act of 1963, Public Law 88-210, as amended, prepared for the Subcommittee on Education of the Committee on Labor and Public Welfare, U.S. Senate, 90th Congress, 2nd Session, March 1968.

One criticism advanced in the 1968 Report of the Advisory Council was that, under the 1963 Act, the Commissioner of Education failed to direct and require the states to evaluate their own performances.[4] The Report also pointed out that the states, because of this failure in leadership, did not collect data and information which would be useful to the Advisory Council in making its evaluation.[5] The Advisory Council noted that although the available data might serve as a basis for regulation they were not satisfactory for evaluation purposes.[6]

In fact, it can be asserted that the collection of data in all fields of social action is generally directed toward the accountability of expenditures rather than the accountability to objectives. But, accountability to objectives is still insufficient. Despite the fact that the Advisory Council, in 1968, reported that "There is little evidence" that the two new basic purposes of the Vocational Education Act of 1963 have "been accomplished so far," it could be argued that, even if these purposes had been accomplished, there is still insufficient evidence on which to evaluate the performance of vocational education.

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[2] Evaluation for a Changing World of Work, U.S. Department of Health, Education, and Welfare, Office of Education, Washington: U.S. Government Printing Office, 1963, p. 217.

[3] Ibid., p. 213.

[4] Notes and Working Papers Concerning the Administration of Programs, op. cit., p. 30.

[5] Ibid.

[6] Ibid.

This conclusion might, in the minds of most educators, be a complete non sequitur. What are the ingredients missing in an evaluation which reveals the attainment of objectives?

B. Cost-Effectiveness as an Evaluative Technique

The fact is that the evaluation of any program must take into account the costs of achieving a set of objectives. This element is not introduced simply to reduce educational goals to materialistic considerations. Rather, it is introduced because conceivably any objective can be attained if unlimited funds are available. But unlimited funds are not available. It is important to determine whether the same objectives might not be achieved through alternative means at lower costs. Any evaluation which concentrates on objectives achieved and which disregards costs is as faulty as any evaluation which concentrates on costs and disregards the attainment of objectives.

In fact, this failure to consider both costs and benefits has been the fundamental weakness of the entire area of evaluation in the field of education. Evaluation techniques which have been applied in education for decades have been inadequate because they have failed to recognize this weakness.

This study was designed to overcome this weakness. It is concerned with what is done for students in terms of such objectives as earnings, employment stability, and citizen and community participation. It is also concerned with the costs involved. This combination is what distinguishes this study from other evaluative studies which have failed to take both factors into account.

The problems referred to by the 1968 Report of the Advisory Council, namely, a failure of the leadership at the national level to provide an adequate framework of evaluation and a failure on the part of the states to develop data for an appropriate evaluation, still prevail. And these failures will persist as long as administrators think that evaluation of the type being suggested (cost-effectiveness) might represent a threat to the existing educational institutions.

C. The Objectives of this Study

This study of the cost-effectiveness of vocational education has two fundamental objectives. First, and most importantly, it was designed to develop an appropriate methodology for the conduct of such a study. It is anticipated that, on the basis of this methodology, federal and state agencies can begin to conduct cost-effectiveness studies in vocational or other types of education. Second, the study was designed to obtain data in order to demonstrate the extent to which such a study can actually be carried on.

With respect to the first objective--the development of an appropriate methodology--the investigators were confronted with many serious theoretical issues. These are fully explored in the report and many of the limitations and uncertainties are clearly revealed. These limitations are not presented as evidence of the inability to conduct a cost-effectiveness study, but rather as information on the basis of which other scholars can work on these problems and, hopefully, come up with more appropriate solutions. After all, all decisions implicitly involve cost-effectiveness "thinking." To demand of an explicit cost-effectiveness study that it attain perfection while to continue to utilize an implicit, irrational type of decision-making, is out of order. The current state of knowledge on cost-effectiveness is not perfect. But it is better than simply guess and intuition. It adds the element of knowledge to these other two elements of decision-making.

With respect to the second objective--the collection of data --the report not only describes the actual data collected but also sets forth the inadequacy of some of the data available. In this area the study can make a significant contribution if vocational education administrators (in fact, all educational administrators) would begin to develop data which permit an appropriate evaluation of their activities. Here, too, the question can be raised as to the validity of the conclusion of this study--that there is pay-off to vocational education when compared to nonvocational education-- if the data are somewhat inadequate. But, conclusions on this question are currently being drawn without any data! The concept of "good enough" has been applied to this study. Here, too, it is hoped that this study can make a contribution to others who are interested in the improvement of the data required for this type of analysis.

Although not intended to be major elements in this study, consideration is given to two other issues that have arisen in the area of vocational education. One is the relationship of the vocational education curriculum to the school dropout problem. The second is the influence of vocational training on the costs of training incurred by employers when graduates are employed by them. With respect to both issues major consideration was given to the formulation of the issues and limited data were collected.

With respect to the relationship between curriculum and the incidence of dropouts, a significant point made in this study is that the inability to conduct a perfectly satisfactory experiment to determine if any such relationship exists precludes an investigator from arriving at a definitive answer. This analysis illustrates the necessity to formulate issues correctly before one attempts to obtain data.

On balance one can inquire whether, given the remaining conceptual problems and the relative inadequacy of some of the data, the results of the study can be utilized for the purpose of policy decisions. One must consider the alternative approaches which have been, and continue to be, employed. On this basis the conclusions of this report are more valid, or possibly less invalid, than those based on incorrect formulations of the issues and no, or less than adequate, data.

CHAPTER II

THEORY OF PUBLIC EXPENDITURES FOR EDUCATION

A. Introduction

Educational services in the United States, especially the elementary and secondary schools, are supported primarily by public funds. In the fiscal year 1945-46 total educational expenditures by federal, state, and local governments were about $4.4 billion. They increased to $32.3 billion by the fiscal year 1965-66.[1] Allowing for changes in the price level during this period, the expenditures in the fiscal year 1965-66 were more than four times higher than in the fiscal year 1945-46. Allowing for both changes in the price level and growth in population during this period, the per capita public expenditures for education in the fiscal year 1965-66 were still three times higher than in the fiscal year 1945-46 (i.e., $48 in 1945-46 and $148 in 1965-66, in 1957-59 dollars). This increasing trend of public expenditures for education reflects the public expression of increasing demand for education.

What are the rationales governmental bodies use to spend a large share of public revenue (about one-sixth in the fiscal year 1965-66) for education? Are there guidelines for determining "optimum" levels of public expenditures for education? How do public expenditures for vocational and academic education fit into these guidelines? And, finally, are there any feasible means to evaluate these different educational programs on which public funds are expended? The discussion of this chapter will focus on these questions.

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1. Joint Economic Committee, Congress of the United States, Federal Programs for the Development of Human Resources, Vol. I., December 1966, p. 8.

B. The Nature of Education

Needless to say, education has its cultural and social value. However, from the viewpoint of economists, education also has its economic value. That is, educational services produced by schools are both a consumption good and an investment good. If one pursues education because knowledge is desired for its own sake, or if one considers that education can enrich one's life through increasing the variety and depth of intellectual pursuits, then educational services can be treated as a consumption good. In this sense, education is an end in itself. However, if one obtains educational services solely because of their impact upon future occupational choices and earnings, then educational services can be treated as an investment good. In this case, education is a means toward an end. It is understood, of course, that while educational services are both a consumption good and an investment good, an end and a means, the consumption and investment aspects vary for different kinds of education and for different people.

During the past decade, economists have largely emphasized the investment aspect of education.[2] Investment in human resources, especially education, is considered an important factor affecting the amount of saving and capital formation and, in turn, the long-run economic growth of the economy.[3] Education also affects the structure of wages in the labor market and thereby the structure of relative earnings.[4] Indeed, the results of economic research on education testify to the importance of the investment nature of education.

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[2] 2. The most important contribution in this area is T.W. Schultz, The Economic Value of Education, (New York: Columbia University Press, 1963).

[3] 3. For example, Robert Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, August 1957, pp. 312-323.

[4] 4. For example, Gary S. Becker, Human Capital, (New York: Columbia University Press, 1964), pp. 7-66.

C. The Role of Government in Education

Even though the economy of the United States is primarily market oriented, the activities of government have substantial effects on educational services. And though the role of government in education varies at different levels--federal, state, and local--it is possible to summarize the general rationale for governmental support of education. The following discussion focuses on the justification for government support of elementary and secondary education.

Satisfaction of Public Needs. The desire of the family for a child's education is the private demand for education. But the desires of other members of the community for the benefits of a well-educated citizenry constitute the public demand for education. Important externalities of education are part of the justification for public support.[5] Therefore, the need for education is a public need. Public needs are those needs desired by members of the economy for which, once provided, there is no possibility to exclude nonpayers from obtaining benefit of the services. Accordingly, public education can be considered as a public good.

In the market economy the market principle of price rationing and allocation will fail to provide this kind of public good to society. One solution to this breakdown in the market economy is to provide this service to the public through the budget principle instead of the market principle. According to the budget principle, the quantities of particular services provided are based on consumers' demands for alternative uses of the economy's limited resources.

One can argue that free education to individuals can be achieved through government transfer payments to parents or through subsidies to private schools. However, public schools may be desired because the society would like to have a common set of values and a common cultural heritage.

Redistribution of Income. In the market economy, the allocation of the share of the total product is based on the productivity of the resources (production factors), the quantity of resources provided, and the prices of these resources. The result of this system of distribution is an unequal distribution of income: those

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5. See Burton Weisbrod, External Benefits of Public Education, (Princeton: Princeton University), 1964.

resources which have relatively high productivity and which are relatively scarce will have high incomes. On the other hand, those resources which are less productive or in relatively greater supply will obtain relatively small amounts of income.

Social justice and, in some cases, economic efficiency require moderation of the extent of income inequality in order to provide low income people with an adequate standard of living. The government has several instruments to achieve the goal of income redistribution, for instance, progressive income taxes or heavy inheritance taxes linked with income subsidies to the poor. However, education also plays an important role in achieving the goal of income redistribution. Public education can provide equal opportunity for those who wish to acquire knowledge and skills, regardless of their relative degrees of wealth. Through education one can improve his productivity, reduce his unemployment, and increase his income in the long-run. It is now generally agreed that more highly educated and skilled persons tend to earn more than others, holding other factors equal. It has been shown by Jacob Mincer that education is the most powerful means to achieve income redistribution.[6]

Efficiency in Production. If a production process is under the decreasing-average-cost condition throughout the relevant range of output, it may be more efficient for government to operate this process. To prevent inadequate use of facilities, where decreasing costs are persistent, government should provide the product free or charge a price equal to marginal cost.[7] The use of a bridge is a classic example for marginal cost pricing.

The studies of Hanson[8] and Riew[9] concluded that public schools have economies of scale. Hanson based his conclusions on a sample of relatively large public school systems [i.e., those over 1,500 in average daily attendance (ADA)] while Riew relied heavily on small size high schools (i.e., those less than 1,000 ADA). In reality, public schools attended by the greatest majority of pupils in an area are more likely to attain a scale of operation which provides education at lower average cost than private schools. Unless it is subsidized, a private school has to charge tuition at least equal to its average cost if the school wishes to avoid losses. Thus, the private school may operate on the declining portion of its average cost function and have chronic excess capacity.

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[6] Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," Journal of Political Economy, August 1958, pp. 281-302.

[7] For a detailed discussion see Howard R. Bowen, Toward Social Economy, (New York: Rinehart & Co., 1948), Chapter 17.

[8] Nels Hanson, "Economy of Scale as a Cost Factor in Financing Public Schools," National Tax Journal, March 1954, pp. 92-95.

[9] John Riew, "Economies of Scale in High School Operation," Review of Economics and Statistics, August 1966, pp. 280-287.

Economic Stability and Growth. In the modern economy, the government is not only concerned about optimum resource allocation and income redistribution, but also with the full employment level of the economy and with long-run economic growth. The rapid improvement of technology in the economy may create structural and technological unemployment. It is believed that education can increase one's ability to adjust to changing job opportunities[10] and, therefore, large scale free educational services may provide more stability in an evolving labor market and reduce unemployment.

Capital formation and technology are the two important elements in economic growth. Education can improve these two elements. Schultz estimated that the educational capital in the United States labor force was $535 billion in 1957, or equivalent to 42 percent of reproducible tangible wealth.[11] Denison estimated that education has raised the average quality of labor by about 30 percent during the period 1929 to 1957.[12] He attributed about 23 percent of the 2.9 percentage point growth rate in national income over the 1929-57 period as a result of education. Based on these studies, it is quite clear that an optimal level of investment in education should be insured in order to maintain a stable economy and a high rate of economic growth. Given current institutional arrangements, government at all levels will have to contribute its effort toward achieving this optimum.

Up to this point the discussion has put forth the reasons for supporting the government provision of educational services. There are certain aspects that do not favor government involvement in education, however. For instance, public schools do not always provide freedom of choice with respect to varying consumer income and tastes and, therefore, interfere with consumer sovereignty in education.[13] As an example, some parents may prefer that the amount of resources available to education be used for improving the quality and quantity of teachers and texts rather than for athletic items. But in the public school system there is no way of expressing this preference unless it is done so by the approval of the majority of the parents. Furthermore, under a public school system, the ability of parents to spend extra money on their children's education within the system is limited. If parents want to spend more money, they can only transfer their children to a private school by paying tuition and other costs in addition to the financial burden they must continue to share for public school expenditures.

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[10] Weisbrod, op. cit., p. 23.

[11] Schultz, op. cit., p. 51.

[12] Edward F. Denison, "Education, Economic Growth, and Gaps in Information," Journal of Political Economy, Supplement, October 1962, pp. 124-129.

With regard to efficiency, the private operation of schools may be under the constraint of the profit motive and this thereby provides an incentive for cost minimization. Under the private school system, ill-managed and low quality schools cannot survive due to free competition among schools. Therefore, the private operation of schools may reduce costs and upgrade the quality of education.

D. Optimum Allocation of Public Expenditures for Education--Vocational-Technical Versus Academic

This report is not questioning the merits of public expenditures versus private expenditures for education. It confines itself to a comparison of alternative expenditures programs within the government sector.

A basic assumption in economics is that goods are scarce and that consumers prefer to have more goods rather than less. Therefore, it is generally desirable to employ resources in those uses where they have the highest productivity. Given the total amount of resources available for public education, it is relevant to determine the optimum allocation of expenditures on different programs such as vocational-technical and academic education.

Theoretical Criterion. On the assumption that the goal of government programs is to maximize the social welfare, the social welfare function, with respect to different government programs, may be written in the form:

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[13] Milton Friedman, "The Role of Government in Education," in his Capitalism and Freedom, (Chicago: University of Chicago Press, 1962), pp. 83-107.

$$(1)\quad W = w(g_1, g_2, \ldots, g_n)$$

where W is the social welfare (or it can be denoted as social benefits) and the g's represent the output of different government programs. The maximization of function (1) is subject to the constraint of the government budget, namely

$$(2)\quad B = \sum_{i=1}^{n} (a_i + c_i g_i)$$

where a_i is the fixed cost of the ith government program, c_i is the marginal cost of the ith government program, and B is the total government revenue.

The Lagrangian multiplier is used to solve the maximization problem, that is:

$$(3)\quad w(g_1, g_2, \ldots, g_n) - \lambda \left[\sum_{i=1}^{n} (a_i + c_i g_i) - B \right] = 0$$

where λ is the Lagrangian multiplier. Differentiating this expression with respect to g_i, then:

$$(4)\quad w_i - \lambda\, c_i = 0$$

where $w_i = \frac{\partial W}{\partial g_i}$ is the marginal benefit of the ith program. From this it follows that:

$$(5)\quad \frac{w_i}{w_j} = \frac{c_i}{c_j} \qquad (i, j = 1, 2, \ldots, n)$$

and also that:

$$(6) \quad \frac{w_i}{c_i} = \lambda.$$

Thus, in equilibrium, as shown in equation (5), the maximization of social benefits is achieved if the ratio of marginal benefit in this example of two government programs is equal to the ratio of the marginal cost of these programs; that is, the marginal benefit is proportional to the marginal cost.

An application of this principle to the optimum allocation of public expenditures on vocational-technical versus academic secondary education is to spend resources on each program to the point where the marginal benefit-marginal cost ratio of vocational-technical education is equal to the marginal benefit-marginal cost ratio of academic education. In other words, other conditions equal, if the ratio of marginal benefits to marginal costs of vocational-technical education is higher than that of academic education, then the government should increase its expenditures on vocational-technical education up to the point where the two ratios are equal. This can be done within a fixed budget by shifting funds from academic to vocational-technical education or by expending any extra public funds on vocational-technical education as additional funds become available. More explicitly, the optimum amount of public expenditures for vocational-technical and academic education is at the point where the additional benefits from an additional dollar spent on these two educational programs would be equal.[14]

Measurement of the Theoretical Criterion. The theoretical criterion for the optimum allocation of government expenditures is clear cut. However, when the criterion is applied to government educational expenditures, two major difficulties are confronted. First, the existence of externalities of educational services can cause difficulties in deriving an accurate measurement of benefits or costs.[15] For example, while the financial returns to a student as a result of education can be measured, market forces fail to evaluate the non-financial returns of his education, such as the benefits to future generations or the benefits to his neighborhood. Such benefits as the increased productivity of his co-workers due to his existence as a better educated person are reflected in the market but are extremely difficult to identify and measure. Second, the application of the theoretical criterion to government educational expenditures is more complicated than that of government investment in such areas as highway construction or flood control because the benefits and costs, when involving human resources, are likely to be more general than those measured by simple economic indices such as earnings or employment. The theoretical difficulties in applying benefits and costs concepts to education will be discussed in more detail in the next chapter.

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[14] While this general discussion is couched in terms of comparing vocational-technical with academic secondary education, the actual cost-benefit analysis in Chapters VII, VIII and IX is done on the basis of comparisons between the graduates of vocational-technical and comprehensive senior high schools.

E. Program Evaluation for Decision Making

Program evaluation is aimed at measuring the relative desirability of alternative programs in terms of economic criteria in order to provide decision makers with a rational choice among the alternative courses of action for achieving some stated objective. The program-planning-budget system (PPBS) is one of the most important instruments that has been applied in evaluating different programs both in the government and the private sector. PPBS is a combination of two operational techniques:[16] program-budgeting and systems analysis. These two techniques can be treated as either mutually related or independent.

Program-Budgeting. Program-budgeting was introduced in the Department of Defense in 1961. Previously, defense expenditures were structured in the traditional budget form--by line item. Because the traditional budget form could not determine the feasibility of a weapon system or evaluate its efficiency, Charles J.

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[15] A.C. Pigou, The Economics of Welfare, 4th Edition, (London: MacMillan Co., 1950), p. 183.

[16] Charles J. Hitch, Problems of Application of the Planning-Programming-Budgeting System to Education, a paper prepared for the Stanford Research Institute, Conference on Vocational-Technical Education, Airlie House, Virginia, April 10-12, 1967.

Hitch introduced a system of program-budgeting.[17] The term "program" refers to the ultimate objective of many interdependent activities.

There are two essential characteristics of program-budgeting. First, the budget of government is organized by programs rather than by objects of expenditures, as traditional budgets are usually organized. In other words, program-budgeting is an objective-oriented program structure which presents data on all of the operations and activities of the program in categories which reflect the program's end purposes or objectives. Second, the program shows not only current needs but also future needs for resources, as well as the financial implications of the programmed outputs. The planning function is concerned with time, substance, and resources. In effect, program-budgeting contains two important pieces of information for decision makers: the ultimate objectives and the intermediate objectives of the planned program and the information on financial resource allocation needed to achieve the objectives.

Program-budgeting has been very effective in the Department of Defense. As a result, in October 1965, President Lyndon Johnson directed all federal government departments to introduce a program-budgeting system into their operations.

This study, however, does not attempt to adopt the program-budgeting technique of analyzing the resource allocation problem between vocational education and academic education of high schools. Instead, it will employ the systems analysis technique to evaluate the results of these two educational programs.

Systems Analysis. Systems analysis is a quantitative analysis. It is designed to provide a criterion or standard for decision making so as to achieve some rationality and optimality in the planning. Therefore, systems analysis is a complementary tool for program-budgeting. There are several alternative names for systems analysis, including cost-effectiveness analysis, cost-benefit analysis, utility analysis, or operations research. These terms have the same meaning both from an economic and methodological point of view.

The major concerns of systems analysis are with the assessment of costs (the welfare foregone) and benefits (the welfare gained). System analysis will be referred to as cost-benefit analysis in the subsequent presentation.

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[17] The method of "program-budgeting" was proposed by David Novick of the RAND Corportation who in 1954 presented a systematic exposition of how the technique could be applied effectively to military spending. See his RAND study, Efficiency and Economy in Government Through New Budgeting Procedures, 1954.

Cost-benefit analysis is a technique which concerns itself with the optimum allocation of resources. It is a tool of analysis which assesses the alternative courses of action in order to help decision makers to maximize the net benefit to society. The essence of this analysis lies in its ability to evaluate the total value of benefits against the total costs.

Cost-benefit analysis normally comprises several steps. The first and most important step is the identification of costs and benefits of a given program. This procedure may appear to be obvious, but in practice it raises a number of fundamental issues of methodology and economic theory. For instance, should the tax exemption to a public school system be considered as a cost or not? If considered as a cost, to whom is it a cost? Or, should the reduction of government transfer payments due to education be considered as a benefit or not? If considered as a benefit, to whom is it a benefit? And, especially, how far is one to go in attempting to enumerate and evaluate external benefits and external costs of a program? These problems will be discussed in the next chapter. Table 1 illustrates some important elements of costs and benefits of education. The elements of costs and benefits of both vocational-technical education and academic education of high schools are similar but vary in degree.

Second, it is often desirable that the list of benefits and costs, both private or social, be expressed as monetary values in order to arrive at an estimate of the current net benefits of a program. The benefits and costs are usually reflected via the price mechanism through the working of the market forces of supply and demand. In certain circumstances, however, market forces may fail to reflect all costs and benefits. This is the fundamental distinction between private and social costs and benefits. Therefore, the quantification of all costs and benefits of a program is difficult, if not at times virtually impossible. Assuming that these difficulties have been surmounted, the analyst is left with an estimate of net benefits of the project.

Finally, a comparison must be made of the stream of annual net benefits and the cost stream of the program. There are three basic alternative criteria in evaluating a program:[18] the benefit-cost ratio, the internal rate of return, or the present value of net

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[18] For detailed discussions, see Jack Hirshleifer, et al., Water Supply: Economics, Technology, and Policy, (Chicago: The University of Chicago Press, 1960), Chapters 6 and 7.

TABLE 1

THE DEFINITIONS AND ELEMENTS OF COSTS AND BENEFITS OF EDUCATION

Social	Private
Costs	Costs
Definition: opportunity costs to the society at large (welfare foregone to the society as a result of expending resources on education rather than on other goods or services).	Definition: opportunity costs to the individual (welfare foregone of the individual as a result of expending resources on education rather than on other goods or services).
Elements:	Elements:
1. Schools' direct expenses incurred due to providing educational services (e.g., operation expenses and capital expenses).	1. Students' direct expenses incurred due to attending school (e.g., tuition, books, transportation).
2. Opportunity costs of non-school system inputs (e.g., PTA donations to school, foregone earnings of students).	2. Foregone earnings of students.
Benefits	Benefits
Definition: Welfare gained by the society at large as a result of education.	Definition: Welfare gained by the individual as a result of education.
Elements:	Elements:
1. A greater rate of economic growth (e.g., increased productivity of associated workers).	1. Students' additional earnings due to education.
2. Good citizenship and reduction of crime.	2. A broader appreciation of one's environment.
3. Continuation and exploration of knowledge and culture.	3. The acquisition of knowledge for its own sake.

benefits. Each criterion has its own advantages, but, given real world constraints, the results of each may not be consistent with the other two. In order to apply these criteria, cost-benefit analysis has to make assumptions as to the size of the rate of interest which is to reflect the social or private opportunity cost rate of investment funds. Unfortunately, there are many rates of interest observed in the market, each reflecting the yield on alternative types and mixes of investments. These difficulties will receive a more complete discussion in Chapter IV.

In spite of the evaluation difficulties in cost-benefit analysis, the analysis has been successfully applied in various fields. The pioneering empirical work was undertaken in the 1950's on water resources development.[19] Military defense is a public good of the most fundamental type. It would be stretching terminology to use a "rate of return" to investment in defense. Most of the work on this subject is, therefore, concerned with "cost-effectiveness analysis," dealing with such issues as the relative potency of different weapon systems in relation to given costs.[20] Lately, cost-benefit analysis has been applied to the fields of education, health, urban renewal, government research and development, and other areas.[21] The present study is concerned with the application of cost-benefit analysis in evaluating vocational-technical education and academic education in the senior high school.

F. Summary

Cost-benefit analysis is an economic methodology which concerns itself with the optimum allocation of resources. To evaluate the alternative courses of action in government educational programs, it is necessary to discuss the theory of public expenditures for education. This chapter has discussed the rationales for governmental agencies to spend a large share of revenue for education. Given the total amount of resources available for public education, it is relevant to determine the optimum allocation of expenditures among various educational programs, in this case, vocational-technical and academic secondary education. The optimum amount of public expenditures for vocational-technical and academic education is at the point where the additional benefits from an additional dollar spent on these two educational programs would be equal.

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[19] See for example J.V. Krutilla and Otto Eckstein, Multiple Purpose River Development, (Baltimore: Johns Hopkins University Press, 1958).

[20] Charles J. Hitch and R.N. McKean, Economics of Defense in the Nuclear Age, (Cambridge: Harvard University Press, 1960).

[21] For detailed discussions of these fields see Robert Dorfman, Editor, Measuring Benefits of Government Investments, (Washington: Brookings Institution, 1965).

CHAPTER III

ECONOMIC ANALYSIS AND ITS RELATIONS TO EDUCATION

A. Introduction

Cost-benefit analysis is a procedure by which relevant economic and noneconomic criteria are applied to cost and benefit data to compare the relative merit of alternatives. The basic procedure of cost-benefit analysis therefore is similar to the economic analysis utilized in the decision process of the firm. But in the social sphere cost-benefit analysis differs from the economic analysis of the firm in that it attempts to account for the divergences between private and social elements of cost and benefits used to evaluate the desirability of alternatives. For this reason, cost-benefit analysis may be looked upon as economic analysis from the standpoint of the society and must therefore be based on the concept of social utility or social welfare.

Economic analysis from the viewpoint of society is confronted with numerous complex issues. The foremost among these is the question of what constitutes social utility or welfare. It is difficult or impossible to answer this question because social utility or welfare cannot be explicitly and objectively measured by a single index in the same way the revenue and costs of a firm are measured. In addition, a social welfare function cannot be devised by simply adding individual or private welfare functions because these two types of functions are not necessarily linearly related.

The feasibility of developing a social welfare function and of identifying the interrelationships within a social welfare function has been widely discussed. But the nature of a social welfare function and its determination, and the relation of a social welfare function to individual welfare functions are still not thoroughly understood. In the absence of adequate understanding, social welfare or utility has often been identified with the quantity of goods and services produced in the economy. In other words, the production or addition of goods and services is considered to be an addition to social welfare or benefits. The depletion of goods and services is a reduction from social welfare or utility. But, to repeat, social welfare and the physical addition of goods and services are not the same thing. The latter is only a part of the former.

In the following sections, the problems in the development of a conceptual framework for determining the costs and benefits of education are examined. It is indicated that the nature of investment in education is different from the nature of public investment in physical projects. The conceptual issues of what constitute the costs and benefits of education are discussed. Finally, it is suggested that cost-effectiveness analysis may be a more appropriate evaluation technique for educational problems, although in many respects the criticisms of the use of cost-benefit analysis apply just as firmly to cost-effectiveness analysis.

B. Cost-Benefit Analysis in Education vs. Public Investment Projects

Cost-benefit analysis was initially developed as an "administrative device adapted to a strictly limited type of federal activity," such as the improvement of navigation and flood control.[1] The application of this approach to the analysis of educational problems is only a recent development. Even though public investment (outside of education) and investment in education represent the means through which social goods are provided, they differ in nature substantially. For this reason, it is useful to point out the distinctive characteristics of investment in education in contrast to those of other public investment projects and to consider problems that may be encountered in applying this analytic approach to education.

First, investment in public projects is a means to an end. As such, this type of investment is an intermediate product and does not have any value except to the extent that it facilitates the provision of final benefits to a community or a society. Expenditure on education, on the other hand, is partly a means to an end, an investment, and partly an end in itself. As an end, education has some value as a final product regardless of its effect on productivity. The contribution of education cannot be measured solely in terms of its physical productivity in the same way the productivity of public investment projects is measured.

To continue, public investment projects are undertaken to increase the quantity of output of goods and services. Here, different inputs are combined for the production of goods and services. In this case it is possible to determine the quantity of inputs used, and the total quantity of output produced, actual or potential. In addition, it is possible to measure the direct and many of the indirect effects of a particular investment project. A major purpose of education, on the other hand, is to improve the quality of a factor of production--labor. The concept of quality improvement is real but difficult to measure. Furthermore, an improvement in the quality of labor does interact with other factors. Finally, education has implications which extend over a period of many generations.[2]

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[1] A. R. Prest and R. Turvey, "Cost-Benefit Analysis: A Survey." The Economic Journal, December 1965.

Most cost-benefit studies undertaken in recent years attempt to evaluate: (1) whether it pays to provide certain type of education, or (2) whether more or less resources should be used on a given educational program. The first type of analysis compares "average cost" with "average benefit" while the second type compares "marginal cost" with "marginal benefit". In either case, a meaningful cost-benefit study can be conducted only if it is known that the production and cost functions are the "appropriate" ones. However, the question of the "appropriateness" of cost and production functions of educational systems has rarely been investigated. The evaluation of average and marginal costs on the basis of observed data, therefore, ignores the problem of efficiency in the educational production.

In contrast to a cost-benefit study of education, a cost-benefit analysis of public investment in other areas can usually be based on the production and cost functions indicated in engineering specifications. The question of the efficiency of an existing program or operation does not constitute as serious a problem in public investment as it does in education.

C. Costs of Education

Costs of education may be defined as the welfare foregone in connection with supplying education. Since recipients of education are individuals, the expenditures incurred by an individual in connection with his demand for education may be called the demand costs of education. A community, in response to the demand of its inhabitants, organizes a school system to supply education. The expenditures incurred by the community in connection with this supply may be called the supply expenditures of education.

The sum of the demand and supply costs of education (removing possible areas of double counting) is the total cost of education. These are explicit costs of education which can be quantified with an objective measurement--the monetary unit. The quantification of these monetary costs, however, is not devoid of complications.

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[2] In making this comparison, the complex nature of evaluating costs and benefits of public investment have not been underestimated. What is indicated here is that output of public investment can be more easily defined and measured than that of education. In addition, the relationship of output to inputs is more directly identified in public investment than it is in education.

On the demand side, expenditures on such items as room, board, or clothing represent costs of maintenance which have to be incurred under all circumstances. Whether or not these expenditures should be included in the demand costs is largely a matter of preference. However, as a result of attending school, certain categories of these expenditures will be increased. These extra expenditures together with expenditures on such items as tuition, books, transportation which are peculiar to attending school, ought to be included in the demand costs of education.

On the supply side, the explicit costs of education include current operating expenditures, such as teachers' salaries, heat, light, or supplies, and capital expenditures on physical plant and equipment. Current costs are generally quite straightforward to measure. The problems of evaluating the costs of physical plant and equipment and of evaluating the costs of joint inputs or outputs of a school are discussed in Chapter V.

The supply expenditures of education are not the same as the costs to the community of supplying education. This is so because the resources used in the supply of education may come not only from the community through taxation, but also from tuition paid by students and such external sources as the state and federal government. Clearly, only funds provided by the community itself through taxation can be unquestionably considered as the costs to the community. Tuition paid by students should not be considered as an element of the supply costs to the community. Funds obtained from sources such as state and federal governments should be included only to the extent that the community contributes to the revenues of state and federal government for education.

The determination of an appropriate charge on plant and equipment and the distribution of joint costs are some of the conceptual issues which require clarification. The major conceptual issues in the determination of the costs of education, however, involve the evaluation of costs which are implicit in nature. Clarification of these issues will represent a major forward step in the cost-benefit analysis of education.

For an individual attending school, the most important element of implicit costs is foregone earnings. The amount of earnings which an individual foregoes as a result of attending school is an opportunity cost to him if his education is a free choice. But if his education is not a result of free choice but a result of compulsory education or child labor laws, the foregone earnings do not exist to the individual since he has no economic choice to make in this case.

The conceptual issue involved here is this: forgone earnings represent a cost to an individual student to the extent that his education is a free choice. Does it follow from this that foregone earnings should be imputed as an opportunity oost to the community or the society? This point may be clarified to some extent if the imputation procedure is indicated.

In measuring foregone earnings as opportunity costs to society, the usual measurement procedure is to identify as foregone opportunity those returns which can be earned in employment instead of going to school. On the assumption that earnings reflect productivity, foregone earnings determined in this manner represent the marginal productivity of an individual under the existing skill structure, the relative supply of labor by skill and amount and the composition of capital supply. The inclusion of foregone earnings inferred from the existing labor market structure, however, is valid only if the change in the skill composition and relative supply of labor does not cause a change in marginal productivity. Such is not likely to be the case.

If a substantial number of students moved into the labor market, the resulting increase in labor supply would most likely reduce the marginal productivity of labor in general and especially so among these age groups. Thus, foregone earnings inferred prior to such a change in labor supply may greatly overestimate the true opportunity costs to society. In fact, unemployment already prevails in the economy--particularly among the younger teenage and unskilled groups of workers. If a substantial number or all of the students are moved into the labor market, this addition will represent to a large extent an addition to unemployment instead of to production. (However, from the standpoint of society we are still interested in what could have been produced in a full employment situation not what was produced in a situation of less than full employment.) The marginal productivity of students, if moved to the labor market in wholesale manner, could conceivably fall to zero. There could be, therefore, little or no cost to society. The implication of this analysis is that it is an overstatement to impute foregone earnings as an element of cost of education to the society even though foregone earnings are costs to the individual receiving education.

This case against the imputation of foregone earnings as an element of the social cost of education on the basis of the current wage structure can be made stronger if this problem is viewed from another direction. The society in which human beings are members is a dynamic and organic one. The economy is growing and its structure also undergoes continuous changes. Thus, the technical ability and skills required of each member of the labor force constantly increases. Without such skills or before the needed level of skills are secured by a member of the labor force, his economic usefulness to the society is limited or nonexistent. Such technological know-how and skills, however, can be obtained through educational and training processes. In this sense, the appropriate economic function of a youth is to develop his productive potential through education rather than engage in production. The range of time to be devoted to education would vary from society to society, but to the extent that education of each generation is a societal necessity, the opportunity costs to the society which result from putting a youth in education are less than those which would result by prematurely putting him to productive activity. This may be explained in an alternate way: Both the output produced by a youth in production and the knowledge and training that he gains in education increase social utility. But, the utility to the society of knowledge and training received by the youth is greater than the utility to the society of the output he produces. To some extent, then, the flow of students into education rather than immediate production is determined by the technological status of the society, and because of this predetermination, alternatives cannot be said to exist or be foregone.

The imputation of foregone earnings, discussed above, is only one of a fairly large number of conceptual issues involved in the evaluation of the costs of education. Imputation of property taxes, sales taxes and excise taxes is another conceptual issue which is based on somewhat doubtful ground. Since school systems are exempted from property taxes, sales taxes and excise taxes, arguments have been advanced that (1) a property tax loss correction factor should be applied to the assessed valuation of school property; and (2) a tax correction factor should be applied to adjust for current costs of those items bought in the market because non-tax public resources will buy more goods and services.[3]

The objective for the application of these correction procedures is to introduce factors common to private goods into education production so that the two are more nearly comparable. However, whether this imputation procedure increases the validity of this type of analysis should be considered under alternative assumptions.

It is entirely justified to compare different types of private goods and services. For such a comparison, it is not only justified but also necessary to adjust for any discrepancy to arrive at a common basis for comparison. However, the nature of education as a social good is fundamentally different from that of private goods. This difference in nature may be seen in that the relationship of a private good to other private goods can in general be assumed to be additive. The relationship of a social good such as education to private goods, however, is not additive because education is an ingredient of the quality and quantity of private goods and services produced in the society.

In other words, for a given society at a given point in time, the production, distribution, and consumption of private goods and services have education as a necessary precondition. Without a given level of such social goods and services as education, the production, distribution and consumption of private goods and services as they are known would not be possible. Because of this complementary nature of the relationship of social goods such as education to private goods, there is no basis for comparison between them even if one applies adjustment or correction factors to introduce common elements in the two types of goods and services. In short, it is of no great help to make an adjustment to include the common elements in the two types of goods which are fundamentally not comparable.

On the issue of tax imputation, the important question to ask is this: Do taxpayers derive any return or benefits from paying taxes (which after all will reduce their welfare)? The answer is yes, and the answer assumes two forms. The explicit element of the benefit of return to taxpayers is in the form of education provided for the youth in the society. The implicit element of benefit or return is in the form of maintaining or increasing the property or economic values of the community. These returns or benefits--either explicit or implicit--to the tax payments are quite significant.

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[3] Fritz Machlup, The Production and Distribution of Knowledge in the United States, (Princeton, New Jersey: Princeton University Press, 1962) pp. 100-101.

The fact that taxpayers derive returns from their taxes is contradictory to the assumption on which many studies were made that taxpayers secure no returns or benefits from their payments. In fact, as argued above, because of the multiplicative nature of the relationship of education to other goods, no imputation of tax factors are justified.

The argument for the application of tax correction factors is also weakened by the fact that a business firm is a profit organization while a school is a nonprofit institution. If it is necessary to adjust for a tax exemption or a tax loss to make the cost of education comparable with private goods and services, it will be necessary to apply the "profit" adjustment factor on goods and services produced by a school. That is, a dollar spent on education and other social goods and services yields more net output than a dollar spent on private goods and services simply because no profit element is charged by the school administration.

D. The Benefits of Education

The benefits of education may be defined as an increase in welfare associated with education. The evaluation of the benefits of education, however, is not only more complicated than the economic analysis of the firm but also more complex than the evaluation of the costs of education. The reason for the complexity is this: in the evaluation of the costs of education, there is an explicit measure in monetary costs of the resources used up, leaving only implicit elements such as foregone earnings and tax factors to be determined. Benefits of education, being multidimensional, cannot be evaluated with a single measure or index. The functions of education are many: economic efficiency, income redistribution, socialization, or consumption, to list just a few which are very difficult to quantify in monetary terms.

In the absence of a unique objective measure or index of the benefits of education, earnings and employment have frequently been used as proximate measures of the economic efficiency benefits of education.

This use of earnings to represent the benefit of education has its origin in the economic analysis of the firm where revenue represents benefits and expenditures, cost. Earnings and employment, however, are really indices of the benefit and not the benefit in itself. The use of these measures as the benefits of education involves considerable difficulty.

First, there are problems of how to define and measure earnings and employment. Would earnings or the wage rate be more appropriate? If earnings are appropriate, should one include earnings from such things as overtime work?

Second, earnings and employment of the individual are affected by his native ability, motivation, and other personal characteristics. The effects of these factors on earnings and employment have to be held constant before one can arrive at a useful estimate of the benefits attributable to education.

Third, even though the contribution of education to the potential of an individual may be unique, his earnings and employment depend not only on his increased economic efficiency resulting from his education but also on the relative supply and demand for the type of skills for which he is trained, and on structural changes which may occur in the economy.

Finally, the stage of the business cycle has important effects on one's earnings and employment. It is difficult to isolate the net effect of education from changes in demand and supply associated with cyclical changes of an economy.

Aside from earnings and employment, education, however, does produce other tangible benefits to a community in the form of additional tax revenues generated by subsequent greater productivity or larger output. An increase in tax revenues of this nature is attributable to greater production and should be distinguished from those which result from an increase in tax rates. Education may also provide indirect benefits to a community in terms of lower rates of unemployment and reduced needs for other forms of social services. It may reduce expenditures for unemployment compensation, public assistance, and other social services, such as crime protection. The income redistributive effects of these changes are almost impossible to sort out. Yet, they must be if a true measure of net benefit to a community is to be attained.

Unlike the supply of education, where there are substantial discrepancies between costs of education to an individual, the community and the society, there is a reasonable degree of agreement with respect to the extent to which benefits of education which accrue to the individual and to the community, as described above, also represent benefits to society.

Aside from the benefits described above, education plays a vital role in the stability and growth of individuals, communities and the society. From the standpoint of the society, education plays two important functions. These are: 1) to transmit the existing knowledge, and 2) to lay foundations for the exploration of new knowledge about efficient methods for social organizations and use of resources.

Economists have long recognized the importance of invention, innovation, and new discoveries in investment and economic development. Investment, however, depends heavily on technological know-how which in turn is a function of education. The distribution of these benefits over time is so uncertain as to make their quantification impossible.

E. Comments on Previous Studies

In view of the complex nature of the task of determining the costs and benefits of education, it is useful to comment briefly on the conceptual framework, methodology and empirical results of previous studies on this subject. Recent studies of vocational education versus academic education were made by Arthur Corazzini and Michael Taussig.[4] The methodology and conceptual framework of these two studies which tend to limit their usefulness are briefly described as follows.

First, the benefit data used in the Corazzini and Taussig studies pertained only to the period immediately following graduation. The uncertain state of affairs confronting a person during this period casts doubt on the reliability of such benefit data. In addition, Corazzini made the unrealistic assumption that the starting wage rate differential between vocational and academic graduates would persist over a life time. Needless to say, Corazzini was aware of the shortcomings of such an assumption.

Second, both Corazzini and Taussig compared wage rates of vocational graduates with that of academic graduates instead of earnings. This comparison precludes a consideration of the employment factor and, therefore, gives an incomplete picture of benefits in light of the possibility that students may be getting training in inappropriate skills vis-a-vis labor market needs.

Third, Corazzini and Taussig studied the performance of vocational and academic graduates without properly controlling for the socio-economic factors which significantly affect earnings and employment. That is, the indicated differences in the performance of vocational and nonvocational graduates in the Corazzini and Taussig studies might have been due to such things as differences in background of students or school environment instead of the effects of educational curricula.

Fourth, in making a cost-benefit comparison of vocational and academic education, Corazzini and Taussig also implicitly assume that these two types of educational programs are different means to the same end. Corazzini and Taussig did not consider the organic nature of the society where combinations of diversified skills are required. Vocational and academic education can conceivably service quite different noncompeting functions. Vocational education and academic education are, in part, different means to different ends. They undoubtedly are not perfect substitutes in an educational or economic sense. Without rigorously clarifying the circumstances under which meaningful comparison between the two curricula can be made, the studies can yield misleading implications.

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[4] Arthur Corazzini, Vocational Education, A Study of Benefits and Costs (A case study of Worchester, Mass.) submitted to the Office of Education, Department of Health, Education, and Welfare, August 1966. Michael Taussig, "An Economic Analysis of Vocational Education in the New York City High Schools". The Journal of Human Resources, Vol. III, Supplement, 1968, pp. 59-87.

Fifth, Corazzini and Taussig conducted their studies under the implicit assumption that economic variables or quantities are strictly additive. In fact, however, perhaps more than any other type of economic or social activity, the effects of education have a high degree of interdependency. Thus, any change or difference in demand, supply, or any other economic variable would significantly affect the existing earnings and employment quite apart from the influence of education. Furthermore, earnings, employment, and monetary costs are incomplete and not uniquely appropriate indices for decision making in education.

Sixth, Corazzini and Taussig discussed the cost-benefit comparison of vocational versus academic education as if society was static. For example, both Corazzini and Taussig estimate that it costs more to provide vocational training than on-the-job training. They, therefore, suggested that it was cheaper for the society to subsidize employers so that they would provide on-the-job training for vocational students. However, these recommendations did not concern themselves with a consideration of economies of scale with respect to those employers providing training for workers. If employers were to provide all workers in the economy with on-the-job training, production or training facilities of employers might have to be greatly expanded. The result might be that the employers would have to set up training programs which may cost society as much or more than existing vocational training programs within the public school system would have cost.

Finally, but fundamentally, both the Corazzini and Taussig studies cannot answer whether or not vocational education is worthwhile or desirable in an economic efficiency sense. To answer this question, one has to assume that the existing programs are already efficiently operated. This, in fact, is the implicit assumption contained in the Corazzini and Taussig studies. The fact is, however, that vocational and other educational programs may be inefficiently operated and that an assumption of efficiency is simply not valid. Without investigating the cost and production functions of the educational programs to determine the economies of scale, Corazzini and Taussig made inferences on the desirability of vocational education from an improper basis. Their conclusion that vocational education is not worthwhile may be interpreted to mean that economically desirable vocational programs were merely inefficiently operated, and not that investment in them should be cut back either in absolute or relative terms.

F. The Role of Vocational Education

In considering the role of vocational education in society it is useful to recall the concept of factor proportion as it is presented in economic theory. This concept implies that: 1) different factors of production are necessary to make productive activity possible, and 2) an optimal combination of these factors will give efficient production. This concept of factor proportion may be extended to specific factors or resources. In case of human resources, we may infer that: 1) the society requires different types of skills or human resources, and 2) an optimal combination of various types of skills or human resources will enable the society to function most efficiently. The role of vocational education is to provide a particular group of these skills or human resources needed for the efficient functioning of the society.

Specific aspects of the role of vocational education may be considered from the viewpoint of the individual concerned, the community, and the society.

For an individual, one of the most important economic functions that vocational education could perform is to improve his performance as an economically productive person. Direct evidence of improvement in the productivity of an individual is usually reflected in his wage rate and employment. If an individual's wage rate increases or his employment experience improves, it can be said that vocational education performs a useful function for the individual.

An improvement in the wage rate and employment of the individual has direct and indirect implications for the community. Higher wage rates and employment will not only generate larger sources of tax revenue for the community, but they will also reduce the likelihood that the individual will be in need of welfare payments or other forms of assistance. A more steady employment obviously implies a reduction in unemployment, and hence, a concomitant reduction in public assistance arising from unemployment.

An increased tax payment represents an addition to, while the reduction in public assistance reduces the burden on, the fiscal resources of the community. Thus, if vocational education results in higher earnings and more steady employment, given the tax structure, there are positive fiscal effects for the community. It should be noted that such positive fiscal benefits are derived from the real economic benefits, increases in goods and services, of vocational education and these real benefits should be distinguished from purely fiscal transfer payments taken out of a given pool of goods and services. But, from a public finance point of view, the positive fiscal benefits derived from improvement in the productivity of an individual tend to offset any additional costs of vocational programs.

To a community, vocational education plays two important functions. One of these is to provide opportunities for those members of the community who wish to acquire a given type of training. The other is to provide trained personnel required by the local labor market. Each community represents a subsector of an economy. However, one community differs from another in the particular combination of skills it requires. Effectiveness in providing opportunities for training would have significant implications on income redistribution while effectiveness in providing skilled labor will enable the local economy to function more efficiently in an economic sense.

To the society, vocational education has a part in its growth and stability. As technology advances and the economy grows, old industries decline and new industries are developed. Thus, some skills become obsolete while others are newly created or evolve from more traditional skills. An important function that vocational education plays is to provide personnel trained in the new types of skills required by industries affected by the advancing technology. Effectiveness in fulfilling this function will help facilitate and accelerate changes in the structure of the economy.

Vocational education also has an "equity" function brought on by economic fluctuations and long-run economic growth. This function is fulfilled by providing retraining opportunities for those who are adversely affected by economic fluctuations and structural changes in the economy, as well as by providing incentives to capital in-migration by guaranteeing a trained labor force.

G. An Alternate Approach in Evaluation: Cost-Effectiveness Analysis

In view of the difference in the nature of investment in education as compared to other public projects, it is of limited value to apply cost-benefit techniques to education in the same way as they are applied in other public projects. Both extensive and intensive efforts are required to clarify conceptual and measurement issues in the application of cost-benefit analysis to education. Vocational programs, however, can be effectively evaluated with a slightly modified version of cost-benefit analysis known as cost-effectiveness analysis. Unlike cost-benefit analysis, which attempts to quantify benefits of a project in money terms, cost-effectiveness analysis utilizes output variables in non-monetary forms to serve as indices for benefits of specific programs. The output variables are specified by various goals of a specific program, such as numbers of persons trained in a given skill, employment, voting behavior, or level of proficiency on a standard test.

Costs of vocational programs may be studied by a cross-section analysis in the costs of different programs. The interregional and interprogram comparisons should shed some light on factors related to efficient use of educational resources and optimal scale of a program.

Effectiveness of vocational programs can be studied by examining their effects on (1) earnings and employment or unemployment of an individual; (2) the supply of and the demand for vocational education; or (3) the supply and demand for specific types of skilled workers. This last point may be considered from the short-run and long-run viewpoints.

The Evaluation of Earnings and Employment. An appropriate measurement of the effects of vocational training on employment of an individual requires the comparison of the rate (or amount) of employment of vocationally trained persons with the rate (or amount) of employment of those not having vocational training. In making such a comparison, however, it is necessary to hold constant various socio-economic factors, such as personal and family characteristics which affect earnings of individuals. In addition, employment of individuals differs from one skill group to another. For this reason, it is necessary to control or adjust for the productivity differentials among various types of skills. To control for this purpose the national average of earning rates for each skill group may be used. A comparison of the surveys of the two curricula should be made not only for the period immediately following graduation, but also for a period extended over five to ten years so that some idea of the time stream of benefits can be gained.

The evaluation of the effects of vocational education on employment experience can be measured in much the same manner as the evaluation of the effects of vocational education on earnings. The incidence of employment of those who receive vocational programs should be compared with the incidence of those who do not receive vocational training. Like earnings, the stability of employment varies from one skill group to another. For this reason, comparison of rates of employment should take into account the degree of employment instability in various skill groups.

This type of comparison should be made for those who have received vocational education with those who have not received vocational education, within specific skill groups. However, comparison should also be made among different skill groups.

The Demand for and Supply of Vocational Education. The effectiveness of vocational programs in providing training opportunities for those members of the community who wish to acquire training can be measured by comparing the number of applicants seeking training in relation to the capacity of the school system to supply this training and the structure of demand for different types of training. Vocational training programs should be expanded if the number of applicants exceed training capacity of the school system, while a program should be contracted if the reverse is true given that this change in student demand reflects market needs. An evaluation of this nature should specifically take into account the types of programs. It is likely that the number of applicants exceed capacity in some skill groups while the reverse is true in others. The training programs should be revised accordingly to equate the market demand for and the supply of vocational training. The partial result of this action may be the equation of supply and demand on grounds other than economic efficiency, if student preferences are felt to override efficiency considerations.

The Demand for and Supply of Skilled Workers. The extent to which vocational training programs supply skilled workers which are required by the local labor market can be measured by comparing the number of unfilled vacancies and the supply of vocational graduates in each skill group. In order for vocational education to meet the demand of local labor markets, it should curtail training in those types of skills where there is oversupply and expand training in those types of skills where there are unfilled vacancies. Modification of vocational training programs in this manner will have the effect of avoiding and directing oversupplies of labor to the types of skills in which there are shortages.

In order for decision makers in vocational education to implement programs to meet the demand generated by economic growth, it will be necessary to obtain data on the direction and magnitude of change in technological progress and economic structure. These changes are long-run in nature and the data obtained in this way can be used as a basis for determining how existing programs can be modified to provide different types of skills needed by industries experiencing technological progress. Evaluation of this nature, however, cannot be undertaken at the local level. Instead, it should be undertaken at the state, regional or national level.

The procedure for such an evaluation involves the identification of industries experiencing or affected by advances in technology. In addition, the demand for and the supply of new types of skilled workers have to be measured and projected so that vocational programs can be geared in this direction accordingly.

H. Summary

The determination of the costs and benefits of education is an essential element in economic analysis of education. Costs and benefits accruing to an individual, however, are different from those accruing to the community and the society. And, those accruing to the community differ from those accruing to society in many cases. Education, as a component in the production, distribution and consumption of private goods and services is not strictly comparable with private goods and services. Nor is it perfectly substitutable for other public and private goods. Hence, the calculus of choice among competing alternatives does not apply completely to education.

Cost-benefit analysis was originally developed for application in areas of public investment projects. Because of the difference in the nature of education from that in other public investment projects, additional efforts are required to clarify the conceptual problems before cost-benefit techniques can be meaningfully applied to problems in education. For the time being at least, cost-effectiveness appears to be a more appropriate evaluation technique for educational problems.

CHAPTER IV

SPECIAL PROBLEMS IN THE ECONOMIC ANALYSIS OF EDUCATION

A. Introduction

The conceptual issues discussed in Chapter III indicate that the application of cost-benefit and cost-effectiveness analysis in the area of education is, in general, subject to a number of broad conceptual problems and qualifications. This chapter indicates that additional issues in the specific application of the various investment criteria, such as the internal rate of return or the benefit-cost ratio, must be considered before investment techniques can be applied to the economic evaluation of education.

When costs and benefits are both directly measurable in money terms, these techniques can be used with few reservations. When either costs or benefits are not directly or completely measurable in monetary terms these techniques can only give limited, albeit needed and valuable, insights into educational and other investments in man.

B. General Considerations

The Elements of Analysis.[1] There are four basic elements in cost-benefit analysis: costs, benefits, time, and the interest rate by which to discount the costs and benefits. Both the costs and benefits of investment in education occur through time. Different investment alternatives are likely to have different time profiles. The purpose of discounting is to attach relative weights to these cost and benefit time profiles in order to account for the productivity of investment and social or private time preference. In some cases a premium is also added to the interest rate to account for risk. However, such a practice, while pragmatically expedient and commonly practiced, is only theoretically correct where risk is a geometrically compounding function of time. The treatment of risk and uncertainty will be dealt with in a later section of this chapter.

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[1] Much of the discussion which follows is derived from the following: A.R. Prest and Ralph Turvey, "Cost Benefit Analysis: A Survey," The Economic Journal, December 1965; Roland N. McKean, op. cit.; Otto Eckstein, "A Survey of the Theory of Public Expenditure Criteria," in National Bureau of Economic Research, Public Finances: (Continued)

Discounting is theoretically justified for a number of reasons. The first is that the interest rate used in discounting represents the opportunity cost of investment funds: that is, invested wealth usually earns a positive rate of return. Thus, "Y" dollars invested today will yield "Y + X" dollars at some time in the future due to the productivity of the investment. Therefore, reversing the process, to relate this _future_ income to its _present_ value, one must discount the future income stream to the present time when the investment decision is being contemplated. Second, future income is valued less than present income. People have a positive time preference, that is, they dislike postponing consumption.[2]

C. Investment Criteria

There is a variety of investment criteria which are available to the education decision maker. At the simplest level of analysis _benefit differentials_ and _cost differentials_ can be estimated. _The_

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1. (Continued) _Needs, Sources, and Utilization_, A Conference of the Universities--National Bureau of Economic Research, (Princeton, New Jersey: Princeton University Press, 1961); Jack Hirshleifer, _et al._, _op. cit._; Ezra Solomon, Editor, _The Management of Corporate Capital_, (New York: The Free Press, 1959). For additional bibliography, see Mark Blaug, _A Selected Annotated Bibliography in the Economics of Education_, Education Libraries Bulletin, Supp. Eight, Institute of Education, University of London, London, England, 1964; also by the same author, _Economics of Education: A Selected Annotated Bibliography_, (New York: Pergamon Press, 1966).

[2] See William J. Baumol, _Economic Theory and Operations Analysis_, 2nd. ed., (Englewood Cliffs, New Jersey: Prentice-Hall, 1961), pp. 410-413 for a brief exposition of the theoretical rationale of time preference.

pay-back period can also be estimated. The net expected present value, the cost-benefit ratio, the ratio of differences in marginal benefits among programs to differences in marginal costs among programs, the expected annual net benefit, and the expected internal rate of return can be calculated. Under certain conditions, these last four measures are equivalent and provide the same guidance to investment decision making. The conditions are noted on page 39 and exceptions to these comprise the bulk of this discussion.

The Correct Criterion. In general, the most correct criterion for making choices among competing investment alternatives is the criterion of maximizing the difference between the present value of benefits and the present value of costs. However, there are both practical and theoretical conditions which either commonly exist or can be devised which demonstrate that no single investment decision criterion is theoretically correct for all investment situations.[3] This discussion concentrates on only three of the above criteria: the expected internal rate of return; the expected net present value; and the cost-benefit ratio. The other measures are dealt with in only cursory fashion.

Cost and Benefit Differentials. Cost and benefit differentials represent a necessary but incomplete stage of economic analysis. These differentials are useful to show the configuration of the data and to provide the inputs to the proper (for a given set of constraints) investment criterion. However, alone they are not a useful guide to decision-making. Yet, one commonly perceives misunderstanding of this fact. For instance, a given project A, costing X dollars more than an alternative project B, is averred (by its advocates) to be of "higher quality" or (by its detractors) to be "too costly." But "higher quality" or "too costly" in what sense? Both these statements, taken by themselves, are nonsense in terms of economic efficiency. Costs and benefits must always be related to each other. More specifically, marginal costs must be related to marginal benefits. If the marginal or extra costs of two alternative programs are the same, but one has higher benefits than the other, it is possible to assert, other things equal, that the project with the larger net benefit is, in an economic efficiency sense, better than that with the smaller. But how much better and whether only one or both programs are efficient investments cannot be determined without further analysis. And, the confusion becomes even greater when one must make a choice between investing in a high cost-high benefit program and a low cost-low benefit program.

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[3] See, especially Jack Hirshleifer, "On the Theory of Optimal Investment Decision," Journal of Political Economy, August 1958, pp. 329-352, and Martin J. Bailey, "Formal Criteria for Investment Decisions," Journal of Political Economy, October 1959, pp. 476-488.

For instance, which is the greater educational investment between two projects each having a 20 year life span: project A which has an initial cost outlay of $200 and yields an annual benefit of $50 or project B which has an initial cost outlay of $1200 and an average annual benefit of $200? The first may be better than the second; the second may be better than the first.

The Pay-back Period. The pay-back period is a simple ratio of total costs, C, to constant marginal benefit, b, with the constant benefit measured over a given time unit such as a month or year. Thus, C/b equals the pay-back period.[4] This simple index relates costs and benefits to each other and different programs can be crudely judged as to their relative effectiveness. The criterion is to select the investment with the shortest pay-back period. For example, using the illustrative data of project A above yields a pay-back period of four years ($200/$50). Under the same set of assumptions, the pay-back period for B is six years. Thus, by this criterion one should select project A over B, other things equal.

A more general formulation for the pay-back period which accounts for non-constant benefits or costs is as follows:

$$(7) \quad \sum_{t=0}^{n} b_t - \sum_{t=0}^{n} c_t = 0, \text{ such that t is minimized,}$$

where b and c are marginal benefits and costs and t is the number of time periods.

The pay-back criterion, however, suffers from a variety of conceptual flaws. First, it ignores the fact that costs and benefits of competing investment alternatives are distributed through time and have different time profiles. Discounting is necessary to make the different cost-benefit profiles commensurable. Second, the absolute size of net benefits between alternatives may differ but the use of the ratio will obscure this. Third, as with the expected internal rate of return, the pay-back criterion breaks down completely in those cases where investment alternatives are mutually exclusive.

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[4] Under certain conditions the reciprocal of the pay-back period is equal to the expected internal rate of return. For this to occur, all costs must occur in the initial time period, and benefits must be constant and continue infinitely. See Myron J. Gordon, "The Payoff Period and the Rate of Profit," in Solomon, op. cit., pp. 48-55.

In light of these criticisms, consider again projects A and B mentioned above. The pay-back criterion directs one to invest in A and not in B. Assume the life of A and B is 20 years for each. Clearly, if A and B are mutually exclusive and both are discounted over 20 years at a discount rate of six percent, the total net discounted benefits of B would be greater than those of A, \$2292-\$1200 versus \$573-\$200. A decision to invest in A under such conditions would result in a loss to total economic welfare. Thus, the pay-back period criterion has serious conceptual limitations as a decision-making tool and is not highly recommended.

D. A Consideration of Three Criteria

The expected net present value criterion and its variant, expected annual net present value, the cost-benefit ratio, and the expected internal rate of return will often provide the same results in terms of the proper ranking of alternative investments. However, the expected internal rate of return rule is not always conceptually equivalent to the total net expected present value and annual net present benefits rules. These three rules are conceptually equivalent only under some fairly severe assumptions.

These assumptions are:[5]

> ...if and only if (a) capital markets are perfectly competitive; (b) all available projects are completely divisible; (c) there is no interdependency among projects; and, (d) all net returns can be reinvested at their own internal rates of return up to the terminal date of the longest-lived project.

The appropriateness of these three criteria is analyzed below in terms of their possible deviations from these conditions.

Formal Statement of the Criteria.[6] The net expected present value criterion can be stated as follows.

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[5] See Mark Blaug, "An Economic Interpretation of the Private Demand for Education," *Economica*, May 1966, p. 168.

[6] Most of the following formulas are based on Hirshleifer, *et al.*, *op. cit.*

Given the assumptions above and given the appropriate interest rate by which to discount, one should adopt any project for which the present value of the discounted stream of net benefits is greater than zero. Or, if more than one project has net discounted benefits greater than zero at the given rate of interest, adopt that project with the highest present value of net benefits. If funds still exist to invest, adopt the project with the next highest present value, and so on, until funds are exhausted or projects with positive or zero net present values are exhausted.

Computationally, an equation for achieving this measure is as follows:

$$(8)\quad V_0 = \frac{s_0}{(1+i)^0} + \frac{s_1}{(1+i)^1} + \frac{s_2}{(1+i)^2} + \ldots + \frac{s_t}{(1+i)^t}$$

Where:

V_0 is total net present value, i is the rate of interest used to discount; t is the time period; s_t is the sum of benefits, b_t, less costs, c_t.

This formula accounts for the fact that costs may occur in other than the very beginning of the income stream. If conditions affecting the value of the interest rate are expected to change over the time span of the income stream, different values for the interest rate can be inserted at such points.

Using the illustrative data for project A above and given the following assumptions: $i = 6$ percent, $t = 20$; $b_t = \$50$; $c_t = \$200$; and the cost outlay occurs at the very inception of the investment period--the present value of benefits for project A is:

$$(8a)\quad V_0 = \frac{\$0 - \$200}{(1+.06)^0} + \frac{\$50 - 0}{(1+.06)^1} + \frac{\$50 - 0}{(1+.06)^2} + \ldots + \frac{\$50 - 0}{(1+.06)^{20}}.$$

$$(8b)\quad V_0 = \frac{-\$200}{1} + \frac{\$50}{1.060} + \frac{\$50}{1.124} + \ldots + \frac{\$50}{3.207}.$$

(8c) $V_0 = -\$200 + \$47.17 + \$44.48 + \ldots + \$15.59 = \$374.$

And, V_0 for project B is \$1,092, where the assumptions are the same as above except that b_t = \$200 and c_t = \$1,200.

Therefore, if 6 percent is the proper social opportunity cost rate of investment funds, then in pure economic efficiency terms, assuming monetary benefits are a proper index of social benefits, project B (\$1,092) should be preferred over project A (\$374).

If the benefit stream is constant from its inception and continues to infinity, the total present value of benefits can simply be denoted as:

(9) $V_0 = \frac{s}{i}$

Where:

i is the chosen rate of interest used to discount and s is the level of net annual benefit. Here, benefits must begin at time 1 and all costs, C_0, must be incurred at time zero, the immediate inception of the project. Then, $V_0 - C_0$ must be zero or greater in order to invest in the given project. Thus, the net present value of benefits for project A is \$833 - \$200, or \$633, while for project B it is \$3,333 - \$1,200, or \$2,133. The use of higher interest rates in discounting will substantially reduce the disparity between the results of equation (8) and those of equation (9). Thus, at just a 10 percent rate of discount V_0 becomes \$500 for project A and \$2,000 for project B, with $V_0 - C_0$ for projects A and B being \$300 and \$800, respectively. Clearly, the rate of interest by which to discount becomes crucial in cost-benefit analysis since the higher the rate the more severely are the more distant benefits or costs discounted relative to more current benefits or costs.

If the net benefit stream is constant but finite, beginning at time 1 and ending at time t, the discounting formula is:

(10) $V_0 = s \frac{(1 + i)^t - 1}{i(1 + i)^t}.$

Where the symbols are interpreted the same as in equation (8) above.

Thus, for project A,

$$(10a)\quad V_0 = 50\ \frac{(1 + .06)^{20} - 1}{.06(1 + .06)^{20}}.$$

$$(10b)\quad V_0 = 50\ \frac{3.207 - 1}{.06(3.207)}.$$

$$(10c)\quad V_0 = \frac{2.207}{.1924} = 574.$$

And, net benefits are \$574 - \$200, or \$374.

Expected Annual Net Present Benefit. This rule yields investment decision results identical to the expected net present value criterion. The rule is[7]

> ...based upon the principle of finding the level net stream that corresponds to the actual stream of costs and benefits associated with the project.

The formula is as follows:

$$(11)\quad s = \frac{V_0 i(1 + i)^t}{(1 + i)^t - 1}$$

where $V_0 = s\ \frac{(1 + i)^t - 1}{i(1 + i)^t}$ and

the rest of the symbols are interpreted as in equation (8) above.

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[7] Ibid., p. 155.

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In terms of investment decision-making this rule states that, at the chosen rate of interest, one should[8]

> ...select all projects where the constant annuity with the same present value as benefits exceeds the constant annuity (of the same duration) with the same present value as costs.

For both this rule and the expected net present benefits rule, costs, c, and benefits, b, can be estimated separately, simply by substituting either of these two values in equations (8), (10) and (11) where s occurs. Also, V_0 in equations (10) and (11) becomes C_0 or B_0, respectively. Next, the discounted total costs or cost annuity, C_0 or c, respectively, is subtracted from the discounted total benefits or benefit annuity, B_0 or b, respectively. Then, for an investment to occur, the difference, $B_0 - C_0$ or b - c, must be zero or greater. One useful aspect of the expected annual net present benefit rule is that, if only costs (or benefits) are known, annual discounted costs (or benefits) can be estimated. A judgment can then be made as to the likelihood that expected annual net present benefits (or costs) will be as great or greater than their cost (benefit) counterparts.

Using the hypothetical data for project A one has:

$$\text{(11a)} \quad c = \frac{C_0 i(1 + i)^t}{(1 + i)^t - 1}.$$

$$\text{(11b)} \quad c = \frac{\$200(.06)(1.06)^{20}}{(1.06)^{20} - 1}$$

$$= \$17.42; \text{ and,}$$

$$\text{(11c)} \quad b = \frac{B_0 i(1 + i)^t}{(1 + i)^t - 1}.$$

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[8] Prest and Turvey, op. cit., p. 703.

$$\text{(11d)} \quad b = \frac{\$574(.06)(1.06)^{20}}{(1.06)^{20} - 1} = \$50.00$$

The respective figures for project B are c = \$104.52 and b = \$199.63. Thus, in each case, b is greater than c at the chosen interest rate and, in pure economic efficiency terms, assuming monetary benefits are an appropriate index of social benefits, it pays to invest in either project, but project B is more desirable than project A.

The Benefit-Cost Ratio. The benefit-cost ratio tells the decision-maker to invest in those projects for which the ratio of the present value of benefits to the present value of costs is greater than unity. The equation for this rule is as follows:[9]

$$\text{(12)} \quad \frac{\dfrac{b_0}{(1+i)^0} + \dfrac{b_1}{(1+i)^1} + \dfrac{b_2}{(1+i)^2} + \ldots + \dfrac{b_t}{(1+i)^t}}{\dfrac{c_0}{(1+i)^0} + \dfrac{c_1}{(1+i)^1} + \dfrac{c_2}{(1+i)^2} + \ldots + \dfrac{c_t}{(1+i)^t}} > 1$$

The symbols are interpreted in the same manner as in equation (7) above.

Applying equation (12), the data for project A above give the following results:

$$\text{(12a)} \quad \frac{\dfrac{\$0}{(1+.06)^0} + \dfrac{\$50}{(1+.06)^1} + \dfrac{\$50}{(1+.06)^2} + \ldots + \dfrac{\$50}{(1+.06)^{20}}}{\dfrac{\$200}{(1+.06)^0} + \dfrac{0}{(1+.06)^1} + \dfrac{0}{(1+.06)^2} + \ldots + \dfrac{0}{(1+.06)^{20}}}$$

$$= \frac{\$574}{\$200} = 2.87$$

The ratio for project B is \$2,292/\$1,200 or 1.91. By this criterion, project A is preferred over project B as long as the two projects are not mutually exclusive.

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[9] Ibid., p. 703.

The Ratio of Difference in Marginal Benefits Among Programs to Difference in Marginal Costs Among Programs. A variation on the benefit-cost ratio is the ratio of the difference in marginal benefits to the difference in marginal costs between two alternative projects. Equation (13) expresses this ratio algebraically as follows:

$$(13)\quad \frac{\dfrac{b_{X_0} - b_{Y_0}}{(1+i)^0} + \dfrac{b_{X_1} - b_{Y_1}}{(1+i)^1} + \dfrac{b_{X_2} - b_{Y_2}}{(1+i)^2} + \dots + \dfrac{b_{X_t} - b_{Y_t}}{(1+i)^t}}{\dfrac{c_{X_0} - c_{Y_0}}{(1+i)^0} + \dfrac{c_{X_1} - c_{Y_1}}{(1+i)^1} + \dfrac{c_{X_2} - c_{Y_2}}{(1+i)^2} + \dots + \dfrac{c_{X_t} - c_{Y_t}}{(1+i)^t}} > 1$$

where, as above, b and c refer to marginal benefits and costs, i is the rate of interest used in discounting, t is the number of time periods, and the subscripts X and Y refer to projects X and Y, respectively.

Briefly stated, this rule says that as long as the ratio of net discounted benefit differences to net discounted cost differences is greater than one, then additional public funds should be invested in project X in preference to project Y.[10]

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[10] To be more specific, the following cases indicate the direction in which an extra dollar of public funds for educational expenditures should be spent. Equation (13) can be expressed as follows:

$$\frac{B_X - B_Y}{C_X - C_Y} > 1$$

where capital B and C represent the summation of the discounted b's and c's. The condition of equation (13) holds true if and only if

1) if $B_X > B_Y$ and $C_X > C_Y$, then additional dollars of public funds should be devoted to project X; or

2) if $B_X < B_Y$ and $C_X < C_Y$, then additional dollars of public funds should be devoted to project Y.

(Continued)

An additional problem with this variation in the benefit-cost ratio criterion should be noted. Even though it is rational to invest extra public funds in project X as long as the ratio expressed by equation (13) is greater than one, this does not necessarily imply that the marginal internal rate of return to project X is equal to or greater than the social opportunity cost rate of capital. Indeed, the marginal internal rate of return to project X could be less than the social opportunity cost rate of capital. Project X may even be suffering net losses. Even so, project Y will be suffering even greater losses, so that a shift of expenditure from project Y to project X (or, the expenditure of an additional dollar on project X instead of project Y), will still result in maximizing net benefits, in this case, by minimizing losses.

The Expected Internal Rate of Return. The result of calculating a rate of return is a simple percentage which can be compared against that interest rate which represents an acceptable rate of social or private investment return. Briefly defined, the internal rate of return is that interest rate which makes the discounted value of costs equal to the discounted value of benefits. One equation for this measure is as follows:

$$(14)\quad E(r) = \sum_{t=0}^{n} (b_t - c_t)(1 + r)^t = 0$$

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10. (Continued) The more generalized version for equation (13) is

$$B_X - B_Y > C_X - C_Y.$$

Under this generalized version, not only cases 1) and 2) can be applied, but also the following cases can hold:

3) if $B_X > B_Y$ and $C_X < C_Y$, then additional dollars of public funds should be devoted to project X; or

4) if $B_X < B_Y$ and $C_X > C_Y$, then additional dollars of public funds should be devoted to project Y.

where: r is the expected internal rate of return; b is the benefit per time period; c is the cost per time period; and t is a subscript denoting the time periods.

In practice, equation (14) is relatively difficult to use and depends for its solution on a technique of successive approximation. However, the use of an electronic computer makes the solution of such a polynomial equation relatively straightforward at least in terms of the physical effort required.

A variant of this equation is the following:[11]

$$(15) \quad c \cdot \sum_{t=0}^{n} \frac{1}{(1 + r)^t} = b \cdot \sum_{t=0}^{n} \frac{1}{(1 + r)^t}$$

where: r is the expected internal rate of return; c is the average cost per time period and assumed constant for all time periods; b is the average benefit per time period and assumed constant for all succeeding time periods; and t denotes the number of time periods. This equation also depends for its solution on a technique of successive approximation.

However, if costs are assumed constant during the training period and if benefits are assumed constant and extend to infinity, equation (15) reduces to equation (16) below and the rate of return can easily be obtained as follows:[12]

$$(16) \quad r = (1 + b/c)^{1/t} - 1.$$

where r is the expected internal rate of return, t is the number of time periods of education in whatever units chosen, (years, months, etc.) and b and c are the marginal benefit and marginal cost per unit of time (years, months, etc.) and assumed constant. The assumption of an infinite discounting stream creates an error which tends to become negligible as the actual benefit stream becomes longer.

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[11] Jacob Mincer, "On-the-Job Training: Costs, Returns, and Implications," _Journal of Political Economy, Supplement_, October 1962, p. 64.

[12] _Ibid._, p. 64.

Using the above hypothetical data, but changing our assumptions so that all investment outlays occur at the end of time period one, yields the following result:

For Project A,

$$
\begin{aligned}
(16a)\quad r &= [1 + (\$50/\$200)]^{1} - 1 \\
&= (1 + .25) - 1 \\
&= .25
\end{aligned}
$$

Multiplying .25 by 100 yields the rate of return of 25 percent. For project B the rate of return is 16.7 percent.

An even simpler equation for estimating the rate of return can be used if one assumes that both benefits and costs are constant, that costs occur only in the initial t time periods, and that the level benefit stream extends to infinity. The equation,[13]

$$(17)\quad r = b/C$$

then applies, where r is the expected internal rate of return, b is the constant benefit per unit of time accruing to the investment and C is total costs over t time periods. Note that this simplified formulation is the reciprocal of the pay-back period discussed previously. For the hypothetical data above, the results of equation (16) and (17) happen to be the same. This would not be the case, though, if cost outlays occurred for more than one time period.

In terms of providing advice to the investment decision-maker, if the social opportunity cost rate of investment funds were as low as 16.7 percent, both programs would be worthwhile. If the social opportunity cost rate of investment funds were as high as 25 percent, only project A would pay. And, if the social opportunity cost rate of investment funds were just 6 percent, both would pay, as the examples above on total and annual net discounted benefits show.

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[13] See Becker, *op. cit.*, p. 107.

Again, this analysis assumes that monetary benefits are a valid index of social benefits. If all costs have been accounted for, but social benefits are higher than monetary benefits, then the monetary rates of return would understate the social rates of return.

Finally, for equations (12), (14), (15), (16), and (17), if either costs or benefits are equal to zero, the criterion breaks down.[14] For zero costs, the situation is mathematically undefined. Zero costs imply an infinite benefit-cost ratio or infinite internal rate of return. If benefits are negative (there are losses) and costs are positive, equations (12), (14), (15), and (16), the benefit-cost ratio and the internal rate of return, give correct advice, a negative ratio or rate of return, as the case may be. But equation (14) and (15) can yield imaginary numbers. Mathematical problems also exist for equations (12), (14), (15), (16), and (17) where benefits are positive and costs are negative, that is, where there are subsidies. But, the subsidy case should not be considered as an investment decision-making situation; what one is essentially dealing with is a gift. When benefits and costs are negative, mathematical problems also exist, but one is still in a gift and not an investment situation.

E. A Critique of the Three Criteria

Much controversy exists over what constitutes the proper investment criterion. The discussion in the literature centers around a critique of the present value and the internal rate of return criteria. The benefit-cost ratio is not widely considered. This latter fact is especially significant in light of federal government practice to employ the benefit-cost ratio as an investment criterion.[15]

Many writers argue that the present value rule is most correct since it automatically assures that the present value of benefits is at a maximum. However, to repeat, both the present value and the internal rate of return criterion will result in the proper and identical investment decision given that: capital markets are perfectly competitive; investment alternatives are not interdependent; all relevant investment choices are completely divisible so that marginal adjustments can be made; and all net returns are reinvested at the original rate of return or higher up to the end of the project with the longest benefit stream. In this context both are correct and neither is to be preferred over the other.[16] However, it is unlikely that these conditions will ever be met simultaneously. The real world imposes constraints such that each of these rules can, at times, give advice which, if followed, will result in the investor not maximizing the present value of net benefits. The following sections consider these constraints in turn. A subsequent section indicates the problems which exist with the benefit-cost ratio.

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[14] 14. The qualifications for equation (13) are discussed in footnote 10.

[15] 15. See, for instance, the discussions in the following: U.S. Congress, Joint Economic Committee, Subcommittee on Economy in Government, "Interest Rate Guidelines for Federal Decision-making," Hearings, 90th Congress, 2nd Session, January 29, 1968, (Washington: U.S. Government Printing Office, 1968).

Constraints Which Invalidate the Rate of Return Criterion

Interdependency. Where two projects are mutually exclusive, the use of the rate or return criterion breaks down. It is possible under this condition of interdependency to invest in an activity which has a higher internal rate of return but lower present value than an alternative project. This criticism is quite relevant from the view of an individual contemplating an investment in himself. When an individual makes a decision which commits him to some irrevocable course of action for a specified period of time, he elminates all other actions he may have taken at that point and for the period which is subsequently committed. If he decides to take training as a carpenter, he usually cannot simultaneously decide to take training as a psychiatrist. In short, one can think of the human as a site or locus upon which, in general, only one type of training can occur at a given point in time. Thus, educational or occupational investments in human beings have the general characteristic of being mutually exclusive.

This criticism of the internal rate of return is just as binding from the social standpoint but the relative magnitude of the consequences stemming from it are probably not as serious. For example, if the construction of a comprehensive high school on one end of town proves to be an economic mistake, one can always construct an area vocational-technical school on a different site in another part of town. Or, an incorrect investment in an individual A does not preclude a correct investment decision to be made with respect to an individual B, since, while one individual is not divisible, a group of individuals is.

Successive Cost Outlays. More than one cost outlay occurring over time will result in more than one rate of return being estimated for the same benefit-cost stream. The same number of rates can exist as there are inflection points where the cost stream switches to a benefit stream and vice-versa. No one of these rates is conceptually correct.

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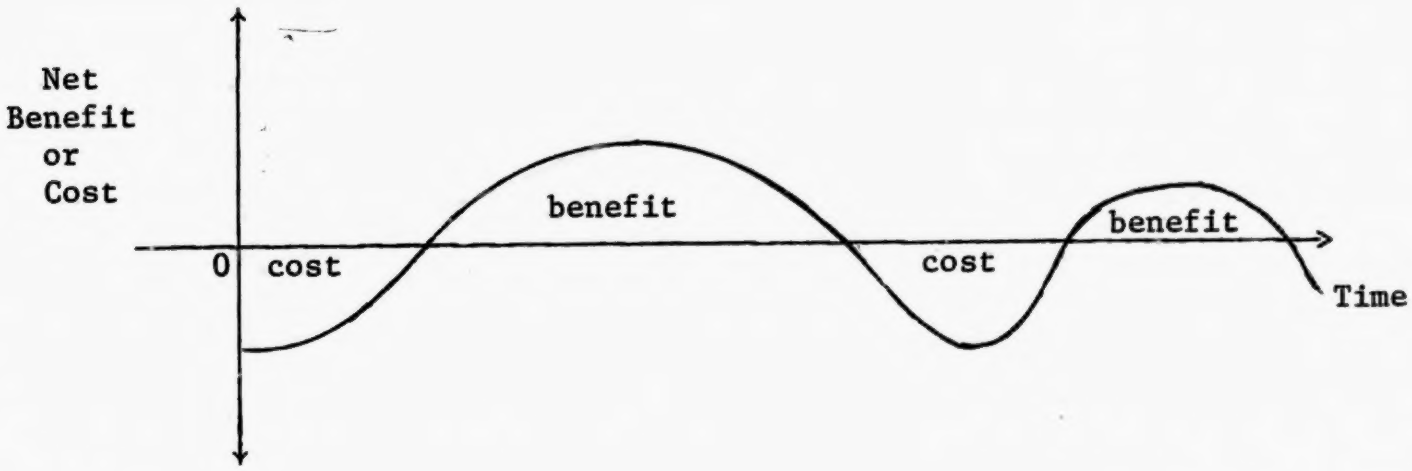
[16] It is important to note again that, as Bailey and Hirshleifer have demonstrated, there are theoretical situations where both rules can give incorrect results.

From the private standpoint the occurrence of multiple cost outlays is a theoretical possibility due to the risk of unemployment. The individual can perceive at least part of the expenditure necessary to maintain him during periods of long-term cyclical unemployment as costs incurred to maintain his productive capacity in a given skill. Thus, he may have a time stream of benefits and costs as appears in Figure 1 below. Here, as many as four internal rates of return could exist. However, it is not likely that short-term cyclical or seasonal unemployment would result in any measurable skill deterioration.

Figure 1: Time Income Stream of an Individual with Multiple Cost Outlays



The unemployment example is similar from the standpoint of society. Although one could argue that in any case society is committed to keeping its members alive, or at least a certain number of them in order to assure its own continuity, it may still incur differential costs which are uniquely associated with maintaining a given skill level. These costs should be counted as necessary costs to assure the viability of the original skill level.

Finally, from both society's and the private viewpoint, if the person had to reinvest in himself due to the fact that technological change had destroyed the economic relevance of his previous skill, this new investment cost and the benefits flowing from it should be treated as an entirely new cost-benefit sequence.

Changing Rate of Interest. Investment in vocational education over time will likely change the distribution of income and hence, other things equal, will also change the social opportunity cost of investment funds which depends, in part, on the distribution of income. In this case, a uniquely calculated rate of return becomes conceptually irrelevant since it does not reflect the changing social opportunity cost rate of investment funds.

F. Constraints Which Invalidate the Present Value Criterion

Multiple Interest Rates. An individual may invest in himself by using personal savings, borrowed funds, or by reducing current consumption. A different private interest rate may be relevant to each of these sources of funds. Assuming the individual did not use some weighted rate of interest to represent these two interest rates and the rate of time preference he attaches to foregone consumption but chose to discount the stream of costs and benefits of different alternatives by each rate, the ranking of alternatives at one rate may differ from the ranking of alternatives at the others. It is then unclear as to which relative ranking is the correct one.

In addition, in many practical situations when a single unambiguous rate cannot be chosen, advice is often given that more than one rate of interest should be used in order to provide a range of estimates of discounted costs and benefits. This again may result in a switch in the differential rankings of alternatives vis-a-vis the different rates. The result will be that choice between investment alternatives will become indeterminate if one attempts to employ both rankings.

A suggested solution to this switching problem involves the selection of that interest rate which makes the net present values of the set of alternatives all equal.[17] This rate then serves as the cut-off point in selecting the appropriate ranking, and hence, the appropriate investment. In Figure 2, the present values of projects A and B are equal at an interest rate of b. If the social time preference rate is always less than b, perhaps rate a, then the present value of project A is always greater than project B and A should be chosen in preference to B. But, if disagreement exists as to what is the proper social time preference rate, for instance, is it rate a or c, then one is no better off than before. The dilemma remains.

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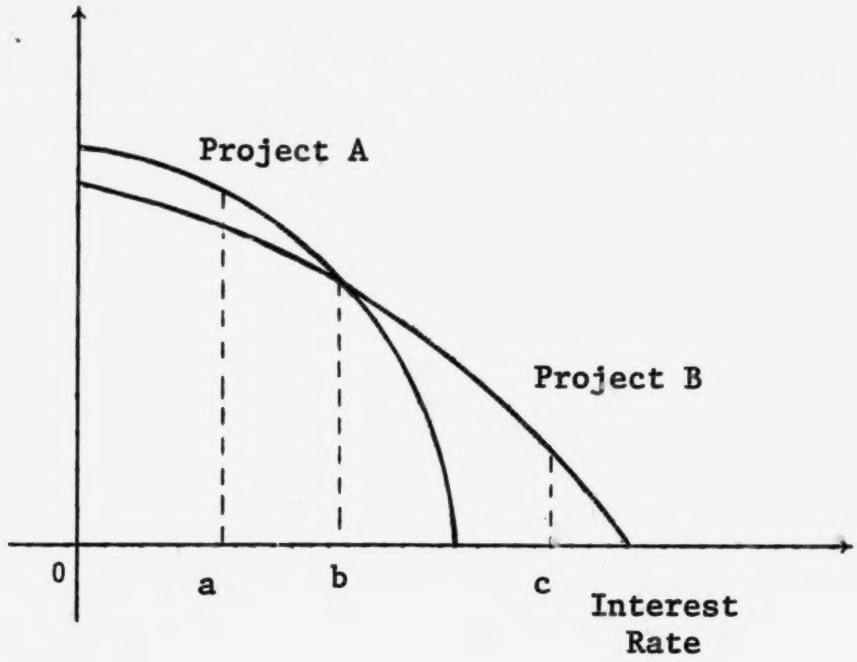
[17] This rate is known as Fisher's rate of return.

TABLE 2

CONSTRAINTS ON DECISION RULES

Difficulties Occur With	
Present Value	Internal Rate of Return
When	
1. Different discount rates are used to evaluate a set of projects with dissimilar time-benefit streams. Result: Different rankings may occur for each discount rate.	1. Projects are mutually exclusive. Result: A high rate of return project may be adopted which precludes the possibility of maximizing net present value.
2. Discontinuities occur such that project costs become large relative to current resources. Result: Adoption of a given project on the basis of its higher present value may preclude the adoption of two or more smaller projects whose summed present value is larger than the original project.	2. The market interest rate varies over the life of the project. Result: The single computed rate of return becomes conceptually irrelevant since all time periods are treated on a par. This is the most fundamental conceptual failure of the rate of return rule.
3. Budget constraints occur. Result: This is a variant of the discontinuities constraint and, again, the likelihood may be that failure to maximize present value will occur.	3. More than one cost outlay occurs over time. Result: a) Multiple rates of return are computed no one of which is conceptually correct; b) Problems of mathematical estimation become extremely difficult.

Figure 2: The Switching of Investment Alternatives.



Budget Constraint. The present value rule will sometimes prove to be invalid when a budget constraint or investment discontinuities face the decision-maker. If one follows the advice to invest first in that activity which has the highest present value, it may well be that some alternative combination of investments will prove possible, each of which requires a smaller investment outlay but which, when taken together, yield a summed present value greater than the single larger investment. For example, given a constraint of \$1000 on the amount that can be invested, project C, requiring a \$900 outlay, may yield a present value of \$1100 while the set of projects D and E requiring outlays of \$400 and \$600, respectively, yield present values of \$600 and \$800, respectively. Present value for a single project is highest for C and it would be chosen over either D or E if one were to follow the rule stated above. But due to the budget constraint and project discontinuity, choosing C precludes additional investment in D or E, each of which have higher internal rates of return than C. Thus, the proper strategy when budget constraints or discontinuities occur, then, as long as the alternatives are not mutually exclusive, is to exhaust the budget by choosing the set of alternatives with the highest internal rates of return. This will actually maximize present value for the set of investments. In this case, one should invest in D and E, to gain a total present value of \$1400 as contrasted with only \$1100 for C.

Such a constraint is a major problem from the standpoint of the individual seeking to invest in himself. As investors, students have limited access to investment sources. Also, students are relatively unproven in the labor market so that there is a great deal of risk and uncertainty concerning the benefit stream of an investment in them. Capital markets are relatively imperfect in the area of human resource investment due, in part, to the unwillingness of creditors to accept a person's own self as loan collateral as well as the quasi-illegality of indenturing oneself. The capital created by the investment in education is real but it is embodied in and cannot be separated from the human agent. It cannot be used as collateral in the same way that physical capital can. High risk and liquidity premiums would have to be charged in addition to the opportunity cost rate of capital if the capital market were to make funds generally available to investors in this area.[18]

Institutional constraints are such that these very high interest rates are not charged. Instead, lower rates are set and the pool of investment funds is rationed among those projects which qualify at the lower interest rates. As a result, investment funds are not generally available to finance one's self-investment at the secondary education level.

Personal loans are made strictly on a person's representation that his actual or expected income stream and, hence, his expected capital value, is of sufficient size and certainty of being realized that he can pay back the loan. Thus, in such cases the loan is made on the basis of accepting the person's expected capital value as collateral, but this practice occurs normally after and not before the person seeking the loan has created the capital value which is embodied in him. In line with this, most student loans made by banks are offered mainly as a public service and are made on the basis of the parents' expected income stream and not on the basis of the great expectations of the student seeking the loan.

Hence, the individual is generally faced with investment budget constraints which do not allow him perfect choice among all possible investment alternatives. He may have access to sufficient funds to contemplate training as a carpenter but not as an electronics technician.

Investment budgets are also constrained from a governmental standpoint, though disagreement exists as to the exact nature and seriousness of this constraint. Legislative limits are set upon amounts to be spent by school districts and other governmental units, for limited and specified periods. Even though new funds are voted for new budget periods and the budget periods continue through time, a short-run constraint exists which can be repeated indefinitely.

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[18] See Becker, *op. cit.*, p. 55.

Only in the broadest sense does a constraint exist for the economy as a whole for it is difficult to conceive of a given investment in this area of education which would be so large as to absorb a significant proportion of the gross national product.

G. Constraints Which Invalidate the Benefit-Cost Ratio Criterion

The benefit-cost ratio has some of the operational shortcomings of both the expected net present value rule and the expected internal rate of return. Like the expected net present value rule, its use will cause problems if more than one interest rate is used to discount. That is, the choice of the most efficient investment alternative may switch. However, if budget constraints or discontinuities, or both, occur, then the benefit-cost ratio like the internal rate of return is preferred over the present value criterion. Given the interest rate used to discount, choice of those investments with the highest ratios will maximize net present benefits. But, if investments are mutually exclusive, the use of the benefit-cost ratio, as with the expected internal rate of return, may give an incorrect result unless the returns from the investment are reinvested at an interest rate at least as high as that yielded by the next best alternative and at least through that time period represented by the investment alternative having the longest time profile of costs and benefits.

The numerical examples in Table 3 display the difficulty involved in relying on the benefit-cost ratio as the "correct" criterion. The interest rate used to discount controls the ranking of alternatives. Neither the internal rate of return nor the benefit-cost ratio alone gives the explicit clue as to the correct answer. Y has a higher internal rate of return than X. X has a higher benefit-cost ratio than Y, given a 4 percent interest rate, but the B/C ratio is reversed for X and Y given the 6 percent interest rate. To resolve the conflict an inspection of the net present value is needed! If the market rate of interest is 6 percent, then Z is preferred since investment in four Z projects gives a present value of $7.84 compared to $2.89 for X and $2.88 for two Y projects. The ranking remains the same at 8 percent as at 6 percent, but the present values of X and Y are negative while Z is just at the decision margin.[19]

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[19] Other numerical examples where the benefit-cost ratio is shown to be misleading are in McKean, _op. cit._, pp. 107-113.

TABLE 3

COMPARISON OF THREE INVESTMENT CRITERIA: INTERNAL RATE OF RETURN, PRESENT VALUE OF NET BENEFITS, AND BENEFIT-COST RATIO

Investment	Cost	Benefit		Internal Rate of Return	Interest Rate for Discounting					
					4%		6%		8%	
	Time 0	Time 1	Time 2		B-C	B/C	B-C	B/C	B-C	B/C
X	$100	$53.00	$56.18	6%	$2.89	1.058	$0.00	1.000	-$2.67	0.972
Y	$ 50	$53.50	$00.00	7%	$1.44	1.029	$0.47	1.009	-$0.46	0.991
Z	$ 25	$00.00	$29.16	8%	$1.96	1.078	$0.95	1.038	$0.00	1.000

Source: Hypothetical data.

Assumptions: The investment budget is constrained at $100. Investments B and C can be duplicated in order to exhaust the budget.

The resolution to this switching problem under conditions of budget constraint is to discount at only one interest rate. Note that this single rate is not necessarily the social or private interest rate representing the opportunity cost of capital. The proper rate is the highest marginal rate of return on that set of investment projects which just exhausts the investment budget. Then, those projects in the chosen set which are discounted at this rate must have a present value of zero or greater. Any project with a present value of less than zero when discounted at this marginal rate should be excluded. In addition, the benefits from this investment set should be reinvested at that marginal rate of return, or a higher one. The method for finding the investment set with the highest marginal rate of return is to discount the array of investment alternatives at different interest rates until that set of investment alternatives is found which just exhausts the investment budget.[20] One then chooses the set with the highest rate. However, this technique can be cumbersome and impractical if there are a large number of alternatives and interdependency exists among them. With interdependency, an extremely large number of possible combinations of these alternatives can exist, all of which must be tested.

It is important to note that the budget could conceivably be so constrained that the number of investment projects would be insufficient to include those which would lower the marginal rate of return down to the social or private opportunity cost rate of capital. If the social rate is used in a situation where it is less than the marginal internal rate, then projects will likely be adopted which will not result in maximizing net present value.

However, Hirshleifer points out that even this rule, while a useful and plausible one under conditions of capital rationing or budget constraint, is not strictly correct. First of all, the marginal project may not have an unambiguous rate of return. Second, even if there is an unambiguous internal rate of return, one may choose the wrong course of action, unless consideration is made of the earning value of resources yielded by each project as well as the market rate of interest by which intertemporal shift of benefits of a given benefit stream can be undertaken.[21]

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[20] These arguments are substantially drawn from McKean, _op_. _cit_., Chapters 5 and 7, and Hirshleifer, _et_ _al_., _op_. _cit_., Appendix to Chapter VII.

[21] Hirshleifer, _et_ _al_., _op_. _cit_., p. 171. The numerical example given clarifies these two points. Actually, the examples given by McKean take account of these two factors also, but he does not stress them to the degree they are stressed in Hirshleifer. See McKean, _op_. _cit_., pp. 82-83.

In summary, given the qualifications above, when there is capital rationing (and this is probably a common situation for an individual contemplating investment in himself), the benefit-cost ratio is the proper criterion for investment decision-making, since by choosing the set of investments with the highest ratios he will thereby maximize net present value. When there is no budget constraint, and for society (not a governmental unit) this is usually the case, adopting those projects with the maximum net present value is the proper course of action. The choice of rules for a community or governmental unit should depend on whether or not there is a budget constraint.

H. The Choice of Interest Rate

The previous discussion as well as the examples in Table 3 indicate the critical role which the interest rate used in discounting plays in choosing among alternative investments. It is necessary, then, to select a conceptually correct interest rate by which to discount the cost and benefit stream.

The problem now becomes "what interest rate should one use?" The notion of a unique interest rate is a theoretical construct. Many interest rates exist in the market place. And, a variety have been used in cost-benefit analysis. Economic theory and empirical research have not given any settled answer as to which is the appropriate rate.

The Social Rate. If too low an interest rate is used relative to the true social rate, there will be a tendency to invest in educational programs which yield a smaller increment to individual and social welfare than what otherwise might have been gained. Using an excessively low rate of interest in discounting will not necessarily increase the total amount of investment which will occur. A low rate will simply discriminate in favor of those investments whose benefits accrue in the distant future as against those whose benefits accrue in the near future.[22] Also, using a rate of interest lower than the market rate will result in a smaller future national income than would be the case if the higher rate of return typically prevailing for investments in the private sector is used to discount.

There is a prevailing argument which suggests that individuals acting as an organic social collectivity would choose a lower rate of time preference for discounting social investments than the rate they would choose as individual actors in the private economy when discounting private investments. In the private sector, the principle of consumer sovereignty may lead to intertemporal myopia, and, thus, a slighting of the needs of future unborn generations. But here one gets involved in arguments on value judgments concerning intergenerational income redistribution. What claims, if any, do future unborn generations have on the present generation? If the economy has a positive per capita growth rate in national income, future generations will automatically be more well off than the present anyway. Finally, only imperfect efforts have been made to give empirical content to the concept of a social opportunity cost rate of capital. This rate was estimated at approximately 6 percent.[23]

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[22] Hirshleifer, et al., op. cit., p. 118.

The Social Rate and Government Practice. In light of the prevailing uncertainty as to the true social opportunity cost rate of capital, what has been current federal government practice? Recent hearings have shown that a variety of rates are being used within the federal government.[24] These range from a rate of zero to a rate of 100 percent. The result of this plethora of rates and any unwillingness to impose a single rate on all agencies of government is creation of rather gross misallocation of investment resources of vast proportions within the federal government sector to the extent that projects are comparable alternatives.

Several of the rates used deserve special comment. Rates such as the estimated cost of new money to the Treasury or the average cost of money to the Treasury all understate the true cost of government borrowing, since the government finances only a small proportion of its total expenditure by borrowing. If all government activity were financed by borrowing, the rate the government would have to pay would be considerably higher than the rate currently prescribed, for instance, at 3.2 percent in Senate Document 97.[25] One agency discounts at the Federal Reserve rediscount rate, a policy variable purposely designed to be manipulated to serve the ends of monetary policy and hence so obviously devoid of any normative significance as a representative of the social opportunity cost rate of capital that one wonders on what basis it was ever selected.

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[23] Krutilla and Eckstein, op. cit., Chapter 2.

[24] "Interest Rate Guidelines for Federal Decision-making," Hearings, op. cit.

[25] U.S. Congress, Senate Document 97, "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources," 87th Congress, 2nd Session, 1962.

In the interest of preventing malallocation of investment funds between the public and private sectors many writers argue the rate of return on investments in the private sector should be the relevant rate in discounting social benefits and costs.[26] But, the appeal to the market rate of interest from a normative point of view is weakened by the presence of a whole structure of interest rates and risk factors along with a variety of imperfections in the capital markets. Furthermore, the federal government has a positive interest rate policy and therefore manipulates the market rates.

Finally, while the choice of a proper social rate becomes at least in part a value judgment, if a project is to be pursued in the public sector on other than economic grounds, this action should be decided by votes and not by adjusting the rate of discount downward until the project becomes economically "efficient."

The Social Opportunity Cost Rate and Social Time Preference Rate.[27] While Hirshleifer and others argue that the rate of return on investments in the private sector incorporates both time preference and productivity of investments, Eckstein and others argue that the private rate of return has little normative significance. In contrast, Eckstein and others argue that estimates of the social opportunity cost of capital appropriately discounted by a social time preference rate is the proper procedure to be used in estimating the net benefits of social investment.

> The social opportunity cost (SOC)... is the value to society of the next best alternative use to which resources employed in the project could have been put.

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[26] Hirshleifer, *et al*., *op*. *cit*., Chapter VI.

[27] For a survey of the literature in this area, see the following: Eckstein, "A Survey of the Theory of Public Expenditure Criteria," *op*. *cit*.; Martin S. Feldstein, "Net Social Benefit Calculation and the Public Investment Decision," *Oxford Economic Papers*, March 1964; __________, "The Social Time Preference Discount Rate in Cost Benefit Analysis," *Economic Journal*, June 1964; __________, "Opportunity Cost Calculations in Cost-Benefit Analysis," *Public Finance*, Vol. XIX, No. 2, 1964; and, Stephen A. Marglin, "The Social Rate of Discount and the Optimal Rate of Investment," *The Quarterly Journal of Economics*, February 1963; __________, "The Opportunity Costs of Public Investment," *The Quarterly Journal of Economics*, May 1963.

[28] Marglin, "Opportunity Cost Calculations in Cost-Benefit Analysis," *op*. *cit*., pp. 117-118.

If the social opportunity cost rate is 4 percent, then a dollar yields a constant annual benefit of \$.04 per annum. Given a social time preference rate of, say, 2 percent, and employing equation (9) above, the social opportunity cost of \$1.00 of capital becomes \$2.00 (.04/.02). And, one should invest in no government project which, when discounted at the social time preference rate, does not yield a cost-benefit ratio of 2 or more since \$1.00 of present funds yields a present value of \$2.00.

One flaw with this argument is that, thus far, it has no empirical content. Thus, arbitrary judgment has to be exercised to choose the SOC rate and the STP rate. Also, rather than discount at a low STP rate and then impose a cost-benefit ratio as a cut off that may be greater than unity, one might as well simply discount at a higher rate and follow the straightforward cost-benefit rules described above. Thus, in the example above, the same results can be achieved by discounting the \$.04 constant annual benefit at 4 percent. This will yield an acceptable cost-benefit ratio of 1.00. Likewise, using equation (17) above, we find the internal rate of return to be

$$r = \frac{\$\ .04}{\$1.00} = .04 \text{ or 4 percent.}$$

The Private Rate. What private rate of interest should the individual use to discount the future stream of benefits flowing from such investment? The most common prescription is that the private rate of interest should be the lending rate of interest if savings are expended to accomplish this investment. This rate will then vary, depending on whether a person is a risk-seeker or a risk-avoider. If he is a risk-avoider, he may choose to invest in those activities which have a low risk of default or failure. The lending rate may be as low as 4 to 5 percent. If he is a risk-seeker, then the private rate may be much higher, perhaps reflecting the average rate of return one can earn on some representative portfolio of common stocks.

If the person is borrowing funds to finance investment in himself, then the private rate of interest should be the borrowing rate of interest. Multiple rates could be involved here, too. For instance part of the funds may be gotten from a loan company at rates of 15 percent or higher, while the student could be financing the remainder of his investment costs with a loan from his educational institution at a rate of 2 to 6 percent. As noted above, this lack of a unique rate will cause difficulties in deciding between alternative investments when the present value rule is used.

If the person is financing his investment directly from current consumption and not past savings, then his private rate of time preference is the applicable rate.

In short, one can assert that there is no one correct interest rate to use in discounting, either for the individual or for the economy as a whole. Both the social and private opportunity cost rate of investment funds may differ from some chosen empirical measure of the "market rate of interest."

Risk and Uncertainty. At the beginning of this chapter it was suggested that consideration be given to the presence of risk and uncertainty occurring in investment decisions. This point requires further clarification. First, it should be stated that there are two types of risk: 1) the risk that a borrower may default in the repayment of principal or interest on a loan; and 2) the risk inherent in an investment project itself--the fundamental fact that the realized stream of net benefits flowing from a project may turn out to be considerably different from the *ex ante* estimation of this benefit stream when the project was being considered for adoption. Indeed, the benefit stream may fail to materialize at all. When governmental units borrow, at least at the federal level, investors run little or no risk of default, but all investors, whether private or governmental, run the risk that their investment expectations may fail to be fully realized. When the likelihood of this failure is known, a risk situation exists. When there is no knowledge of the possible range of outcomes, a situation of uncertainty exists. Risk can be hedged against. By its very nature, uncertainty cannot. Thus, each of these two situations should be handled differently in economic analysis.

Two practical techniques exist for the handling of risk.[29] The first is to apply a risk premium to the interest rate used in discounting. The second is to estimate the probability distribution of outcomes. That is, a determination of the range of outcomes to an investment should be made and the probability of any given outcome occurring within that range should be estimated. Then, by weighting the outcomes by their probabilities, a weighted value of the probable outcome of the investment project can be estimated. This notion is conceptually superior to the simplistic application of a risk premium in discounting. However, such knowledge of the probability distribution of outcomes is usually not known so that one is thrown back to the use of the risk premium. The use of a risk premium automatically, via the geometric compounding of the discounting procedure, assigns a higher weight of risk to future than to present benefits. However, the choice of the proper risk premium is not self-evident. Also, the choice of a unique risk factor assumes that the degree of risk in investment outcomes is not in itself affected by the passage of time. But, this can be adjusted for by changing the risk premium over time. That is, one can apply a risk premium of, say, 2 percent, for the first 10 periods of an investment benefit stream and apply say, 15 percent to the remaining periods of the benefit stream. Finally, this approach simply cannot represent the full range of possible outcomes. What it does, in effect, is simply shorten the expected stream of benefits.

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[29] Most of this discussion is based on Baumol, *op. cit.*, pp. 453-460.

Uncertainty and Sensitivity Analysis. Where no knowledge of the possible outcomes of events is known, a situation of uncertainty exists. Some knowledge of the effect of this uncertainty on the decision-making process can be gained through the use of sensitivity analysis. This technique involves the testing of each element of the investment model to determine those elements which have the greatest impact on the expected outcome, when their values are changed in a predetermined manner. Estimates of the likely range of values for the more volatile variables can be made and the range of outcomes can then be estimated. Often, the rate of interest used in discounting will be one of the most volatile variables in an investment decision situation.

The example in Table 4 using the capital recovery factor (CRF) to estimate annual capital equipment costs is illustrative of the application of sensitivity analysis. Capital equipment costs to any given training program are affected by a variety of factors. Two of these are the expected economic life of the investment funds. Further, average capital costs per student are affected by the number of students in a class, the intensity of use which they make of the equipment while in class, as well as the number of classes using the equipment over the course of time. The economic life of equipment is very uncertain. Obsolescence can occur well before the equipment is worn out in an engineering sense. Likewise, the true social opportunity cost rate of investment funds is not known with precision. What happens to the rate at which capital costs must be recovered as these two parameters vary systematically? An inspection of Table 4 shows that for a project life of 5 years and an interest rate of 6 percent, the CRF, the annuity based on the original cost outlay, is $8,380. Increasing the social rate of interest to 10 percent, a relatively high rate, raises this to $9,312, or by about 11 percent. But raising the project life to 15 years (at 6 percent) reduces the CRF to $3,636 (or by about 43 percent), as compared with the 6 percent, 5-year life. In contrast, raising the project life from 5 to 15 years at 10 percent lowers the CRF by almost 50 percent. The difference between these two percentage changes is due to the effect of geometric compounding of the higher interest rate over the extra 10 years of projected life. Of course, the other factors mentioned above, such as class size,

TABLE 4

APPLICATION OF SENSITIVITY ANALYSIS TO THE ESTIMATION OF AVERAGE ANNUAL CAPITAL COSTS FOR THE MACHINIST SKILL. ORIGINAL SHOP OUTLAY, \$329,561.[a]

Economic Life of Project	Average Annual Capital Cost	
	Six Percent	Ten Percent
5 years	\$8,380[b]	\$9,312
10 years	\$4,797	\$5,743
15 years	\$3,636	\$4,642

[a] Data are derived from the actual cost of installing a machine shop in a vocational-technical school in City A.

[b] The capital recovery factor (CRF) herein estimated is based on equation (10). A detailed discussion of the CRF is in Chapter V.

will further alter the structure of capital equipment cost. The astute application of such analysis can help reveal the possible range of cost outcomes.

I. Summary

In appraising the operational effectiveness of cost-benefit analysis, the following list of factors should be kept in mind.

1. Discounting the stream of benefits and costs must be performed.
2. The relevant value for the social opportunity cost rate of investment funds probably lies in a range of from 6 to 10 percent.
3. The use of an artificially low rate of interest when discounting may not increase the total amount of investment. It may just result in the displacement of some high return investments by low return investments, with a resulting loss in present and future economic welfare.
4. Although the fundamental goal is always to maximize the net present value of benefits, there is no one correct investment criterion for all investment situations. This is true both in a theoretical and an operational sense. The constraints involving a given investment situation should be examined and the rule most relevant to that situation applied.

CHAPTER V

DATA NEEDS AND PROBLEMS

A. Introduction

Since the basic orientation of this study is on economic benefits and costs, the fundamental concern of the discussion of this chapter centers on economic data needs, problems, and methodology. Fundamental, but not exclusive, reliance is placed on the identification and measurement of money benefits and costs, with the full realization, however, that such a money index of cost-benefit calculation is not necessarily the most effective index for measuring the costs and benefits of education, even if such analysis is confined solely to the measurement of the efficiency objective of education.

Given this qualification, one should measure both social costs and private costs, and, in some cases, governmental costs, those costs incurred by communities or governmental units, though this latter category of costs is not considered in this discussion.

As stated previously, all costs must be considered as opportunity costs. That is, they represent the foregone benefits of opportunities which cannot be pursued due to following a given line of economic activity. Thus, the cost elements discussed below each represent the cost of foregone alternatives. They are discussed separately simply because different measurement problems tend to arise with each, and not because the cost elements themselves are theoretically different. Each of these cost elements will be considered in turn, first for social, then for private costs.

Under social costs, the following should be considered:

1) Current costs, which include such factors as teachers' salaries, heat, light, and other variable costs;

2) Capital costs of sites, buildings, and equipment;
3) Cost correction factors such as sales tax and property tax correction factors;[1]
4) Costs from nonschool system support;
5) Earnings foregone while students are undergoing education;
6) Incidental costs to students associated with school attendance;
7) Job search costs; and,
8) On-the-job training costs.

Under private costs the following should be considered:

1) Earnings foregone while the student is undergoing education;
2) Tuition paid, if any;
3) Incidental costs associated with school attendance;
4) Job search costs; and,
5) On-the-job training costs.

B. Social Costs

Total, average, and marginal social costs should be measured and these costs should be related to the production functions which incorporate those variables which affect their determination and structure, such as class size, number of course offerings, classroom equipment, or number and quality of teachers. Cost-benefit analysis is concerned with the making of decisions which allocate resources efficiently, so that, in this regard, the main concern of this analysis is with the determination of marginal, or extra costs. (Likewise, on the benefit side, the major concern should be with marginal, or extra, benefits and the relationship between marginal costs and marginal benefits.) Problems of cost determination will occur with respect to measurement of total and average costs of a given output or set of joint outputs when a situation of joint cost occurs.

The Joint Cost Problem. The problem of joint costs occurs within two contexts. First, the problem exists at a given point in time when a specific educational expenditure or facility is used to produce two or more distinct educational outputs. Second, the problem occurs over time, when a facility is consumed during the investment or training process by successive cohorts of students representing either the same or a different type of output.

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[1] See Chapter III for a discussion of this cost correction factor. Since this problem is discussed in Chapter III, it will not be covered here.

Fortunately, the occurrence of joint costs does not affect the determination of marginal costs. And, since efficient investment decisions between two or more alternative projects are made on the basis of marginal costs, the presence of joint costs presents no basic problem to cost-benefit analysis.

In actual practice, however, costs which are joint are frequently allocated among different programs. Not only is such allocation of necessity arbitrary in nature, but it is unnecessary, given the above emphasis on marginal costs. When joint costs occur and involve two or more programs or outputs, the total cost of the set of programs or outputs combined can be measured. Then, in cost-benefit terms, the combined total discounted benefits of the set of programs or outputs should equal or exceed their combined total discounted costs. But total average costs to each of the two programs simply cannot be measured accurately in any economic sense. This is no real loss, though, since, to repeat, investment decisions between two or more programs are correctly made only on the basis of marginal and not average costs. And, to re-emphasize, marginal costs can be measured even in the presence of joint costs.[2]

Consider the following: Both vocational and nonvocational training occurs in a comprehensive senior high school. In this school certain costs are directly attributable to a given program in vocational education, such as the extra costs of electricity to run the power tools of the machine shop or the extra wiring installed in the shop room. However, the building itself needs a given electrical system to feed electricity to all the various classrooms and shops. This cost outlay serves both the vocational and nonvocational students as does the expenditure of electricity to light the halls, restrooms, other classrooms, auditoriums, or gymnasiums which are used in common. Given that a decision has been made to install a machine shop in that school, no part of the common cost of constructing the basic school building should be included as a cost offset to the benefits flowing from the machine shop. The correct allocation of these common costs to the machine shop operation, and by extension, the costs of training students as machinists, is, simply, zero.[3] This is so because, within the limits of the feasible range of output in the school, the use of the common facilities by the students taking machinist training does not reduce the ability of the other students in the school to use the same common facilities. Within very broad limits joint inputs are similar to what is known in economic analysis as a public good. Just as the benefits from a public good are pervasive and cannot and need not be rationed or allocated on an individual basis among consumers since one person's consumption does not diminish the consumption of that same good by other consumers, so, too a joint input need not and cannot be allocated among the outputs stemming from it.

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[2] See, for instance, Hirshleifer, et al., op. cit., pp. 93-94 and McKean, op. cit., pp. 44-46.

What is to be done, then, when a given investment expenditure such as the construction of a comprehensive school yields vocational-technical graduates? To repeat, the marginal costs incurred in educating each of these two groups should be covered by the respective marginal benefits to the groups. And the total costs, marginal plus joint, should be covered by total benefits flowing from the school as a whole.[4]

Current Costs. Some current costs will be specific and some will be joint. Given a comprehensive school which produces more than one type of product or provides different types of specialized training, typical joint costs could involve the cost of administration, cost of heating and maintaining the building, the cost of the health, transportation, community services, student body activities, or the school lunch program. Even if, as with the school lunch program, students were charged a fee which reflected the cost of providing lunch to each of them, differences in marginal cost between different students would not necessarily be affected, if, as is often the case, a flat fee would be charged to each student. And, average cost would rise by the same absolute, but not necessarily the same relative amount for the students involved in different curricula. Of course, one would attribute as a cost of education only those costs involved in food preparation and serving which would be over and above what the student would normally incur to feed himself were he not in school.[5]

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[3] In this regard, then, Handbook II, Financial Accounting for Local and State School Systems, is in error in an economic sense in advising the proration of certain types of costs with respect to the different formulas presented in it. These proration formulas generally lack economic significance. See U.S. Department of Health, Education, and Welfare, Office of Education, Financial Accounting for Local and State School Systems, OE-22017, Records and Reports Series: Handbook II, (Washington: U.S. Government Printing Office, 1965), Chapter 8, "Prorating Expenditures."

[4] However, the foregoing, while most theoretically correct, is near to being a counsel of perfection. Indeed, the discussion of the capital recovery factor later in this chapter implies the use of proration. Limited use of cost proration will be made in later chapters of this study.

Specific costs could involve such matters as the cost of the shop or classroom teacher, the cost of supplies and books associated with a given educational curriculum, the electricity or water costs associated with a given curriculum, or maintenance or janitorial services associated with each curriculum.

Capital Costs. Social (and private) capital costs are fundamentally no different in nature than social (and private) current costs, and, thus, what follows should not be construed as suggesting so. Capital costs can be broken down into four different elements:

a) Site acquisition costs;
b) Capital improvements to the site;
c) Physical plant and building costs; and,
d) Equipment costs.

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[5] Controversy exists over whether or not such in-school programs as attendance and health services and community services represent aspects of the educational process. In some respects these programs are similar to other public health and social services and an argument could be made for including such expenditures in these categories within the community at large. However, there are interaction effects between the state of one's health, nutrition, and quality of life and the educational and learning processes themselves. So, total exclusion of such expenditures in an accounting of the costs of education may not be warranted, since these expenditures do facilitate the educational process. A case could be made, however, to attribute the increased effectiveness of the educational process brought about by such things as health expenditures as a benefit accruing from the health expenditure. Our judgment would be to exclude these expenditures whenever possible and recognize that in their presence, the benefits accruing to the educational process per se are overestimated. However, again, this represents a counsel of perfection, and, in fact, the cost estimations of Chapter VII include such expenditures.

There are serious problems involved in measuring capital costs to education. These problems stem from several physical and institutional factors. Two of the most important factors are: 1) the physical plant of the school usually has an economic life longer than the period of training for any given educational cohort; 2) the services of this capital stock are not easily valued in market terms.

Four possible treatments for valuing this capital exist. First, one can argue that once the capital stock exists, especially the physical plant and buildings, it becomes specific to the educational process and thus has no alternative use. In this case, social capital costs would be zero in the short run, since no opportunity cost is involved in their use for a cohort of students which use the capital after the decision was made to create the school. This is a tenuous assumption, though, for it is easy to discover alternative uses for such capital stock. Thus, the value of the educational physical plant is not zero in competing uses, but since it is not a perfect substitute for these competing uses, the market value of the competing uses does not exactly reflect the opportunity cost of using the non-renovated physical plant for educational purposes. If one went to the market to price the value of the non-renovated educational plant in terms of its potential value as a hospital simply by observing what the value of a hospital was, the value would be overstated. Thus, the value is not zero, but it is less than the apparent value of alternatives since, without renovation, it is not a perfect substitute. And, even with renovation, such factors as location, which cannot be changed, continue to exist and reduce the degree of substitutability, thus forcing one to adjust downward the opportunity costs implied by measures of values of foregone alternatives.

Second, historical costs of building construction and site acquisition can be used, but these historical costs are essentially irrelevant since they have no necessary bearing on the present opportunity costs involved in using the capital stock in question. They do not reveal what the current economic value of the capital resource is. Current economic value could be less than, equal to, or greater than historical cost.

Third, the use of replacement costs is a possibility in the attempt to measure capital costs. However, it is obvious that in many cases it would cost more to exactly replace a building than the building is currently worth in economic terms. The use of replacement costs would over-value the capital resource, given a rising price level and assuming no compensating technological change in construction technique.

Fourth, an estimate of current assessed valuation could be used to arrive at a measure of the capital costs. However, the valuation standard used becomes critical. In actual practice, the valuation standard amounts to a combination of historical costs adjusted by a price index of replacement cost so that this measure is no better than the replacement cost measure. Unfortunately, in two of the three cities in this study, Cities A and B, which do report assessed values of their buildings and physical plants for purposes of fire insurance, this is essentially the practice followed.

In short, it is not obvious what price resulting among these four choices should be attached to the capital inputs to get a measure of the opportunity costs. None of the above are correct in a pure theoretical sense. This study, however, will employ replacement costs.

The Capital Recovery Factor. Even if the true economic value of the capital resources in use has been measured, the problem still remains as to the measurement of the rate at which the given capital stock is used up over the course of the investment process when more than one cohort of students employs the capital stock. Two courses of action have been suggested for use. One is to attempt to measure an imputed rent and depreciation to the capital stock by making analogies with respect to what amount of rent (i.e., return on the capital investment) the capital item would yield if it were being employed in the private sector of the economy. Some notion of depreciation is added to this. But such a technique is subject to a great deal of arbitrariness and uncertainty.

In order to get a measure of the rental opportunity cost it is necessary to go to the market place and attempt to identify capital resources which represent alternatives to the resources employed in the educational process. This will allow one to determine the value of foregone alternatives. But, again, any imputed rent based on market observations will most likely overstate the value of the capital resources which are already committed to education. Thus, a great deal of judgment is involved in adjusting the observed market prices so that they more closely reflect the true opportunity costs.[6]

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[6] For a general discussion of the problem of imputing opportunity costs to resources employed in the public sector see Roland N. McKean, "The Use of Shadow Prices," in Samuel B. Chase, Jr., Editor, Problems in Public Expenditure Analysis, Studies of Government Finance, (The Brookings Institution: Washington, D.C., 1968).

An alternative technique for estimating the rate of capital use lies in employing the "capital recovery factor" (CRF). The application of this technique automatically accounts for both rent (interest) and depreciation.

The capital recovery factor is that factor which "...when multiplied by the present value of capital costs, is the level [average] end-of-year annual amount over the life of the project necessary to pay interest on and recover the capital costs in full."[7]

The formula is as follows:

$$(18) \quad c = \frac{C_0\, i(1 + i)^n}{(1 + i)^n - 1}$$

where c is the capital recovery factor (annual capital cost); C_0 is the present value of capital in use; i is the social opportunity cost rate of capital or investment funds; and n is the number of years over which benefits (of the capital in question) are returned, that is, the project life. In some respects, this technique is no less arbitrary than that which imputes rent and depreciation. Apart from the problem of establishing the present value of the capital in use, essentially arbitrary judgments must be made with respect to the values of n and i.

Figure 3 describes how a hypothetical capital usage stream would appear for a school building built in 1917 with one wing added in 1937 and a major renovation occurring in 1957, given appropriate assumptions on the social opportunity cost of investment funds and the time period concerning the flow of benefits related to each capital item. (A major renovation is a renovation which increases the economic value of the capital item in question. At some point, arbitrary distinctions have to be made between what is renovation and what is maintenance.)

The time period over which costs are measured in this study extends from fiscal year 1956 through fiscal year 1960. So, for example, average annual capital costs for physical plant in the example below would be Oa for fiscal year 1956 and Ob for fiscal year 1959.

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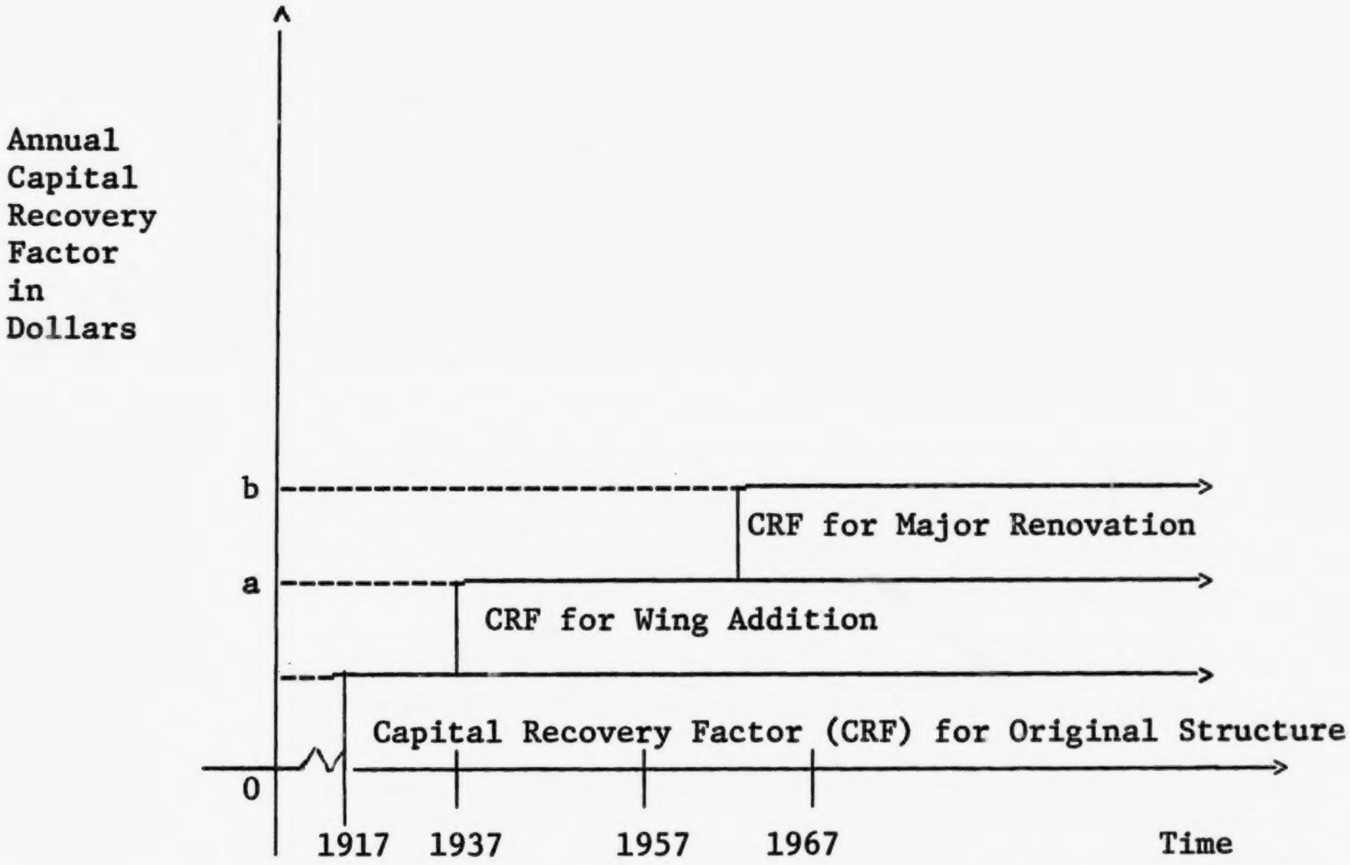
[7] Hirshleifer, et al., op. cit., pp. 158-160.

Figure 3. An Example of Cost Imputation Based on the Capital Recovery Factor



Several problems exist with the use of this technique. The first is that the CRF does not necessarily indicate the amount of capital used in any given year. It only states the level annual amount needed to recoup the principal and social opportunity cost, that is, interest, given the project life. The actual amount of capital used up in any given year could be the same, more, or less than this amount. This fact will bias any investment criterion used.

Related to this problem is the fact that more than one cohort of students may utilize a given capital item during the life of that item. For instance, if a capital item has an economic life of n years and it takes an educational cohort three years to complete its training (investment) process, then at least n-2 cohorts will make use of that capital stock. If a capital item is installed in an on-going educational project, given that it takes 3 years to train a cohort, three cohorts are always using that capital item. Here there is a joint cost problem. In any time period, how much of the capital use is due to each cohort? In the figures given in the following chapter the general prescription against allocating joint costs is violated by combining the cohorts in such a way that the implication is that each uses the capital stock at an equal rate throughout the investment process.

Types of Capital Costs. Site costs and capital improvements to sites are affected by the joint cost problem, unless, of course, a given site or site improvement is uniquely related to a given output. The site itself is indestructible in most cases since the productivity of the site is not reduced by its use by students. However, the site does have an economic cost since it is productive. An interest charge representing social opportunity cost should be paid, but not a depreciation charge, since, conceptually, the site does not depreciate. This cost should be covered by the benefits gained from the educational process. Otherwise, more efficient uses for the site may be foregone, resulting in a loss to total welfare. However, these site costs cannot be sensibly prorated among different educational cohorts.

A serious problem with estimating site costs lies in that such costs are inextricably entwined with the costs of capital improvements to the sites. It is impossible to determine how much of the purchase price of a site is a function of the value of pure rent and how much of it is due to the site improvements.

The cost of the basic building structure, if the school produces more than one type of output, is fundamentally a joint cost and cannot be prorated. As indicated before, the costs of any specific modification to that school, such as an extra expenditure to wire special shop rooms, is specific to the skills trained in those shops or rooms.

The cost of equipment can often be allocated to a given training skill but there is usually an intertemporal joint costing problem between educational cohorts being trained in a given skill.

Cost from Nonschool System Support. Care must be taken to ascertain whether or not the various school systems are subsidized by any branch of the local or state government. Such cost items must be included into total costs. While the school systems of Cities A and C of this study do not receive any substantial support from the cities in which they are located, school system B does. For this and other more serious reasons the cost data for school system B cannot be used effectively.

Foregone Earnings. Only marginal cost differences between vocational-technical and nonvocational-technical high school graduates are relevant. If, at the outset of their secondary education the two groups have essentially the same socio-demographic, motivational, and physiological characteristics, then the original marginal differences in opportunity costs attributable to each group will be small or nonexistent. Different educational processes and curricula can be expected to change the opportunity costs attributable to each group as the educational process nears completion. However, there are no published data which will reveal this. Census data do not report earnings by the various secondary education curricula as a function of years of secondary schooling completed. In this study, an attempt was made to measure the opportunity costs of continuing the last two years of high school education by estimating the earnings which senior high school dropouts receive from the time they drop out until the time they would have graduated. The differences in earnings between vocational-technical and comprehensive senior high school dropouts proved not to be statistically significant. (See Chapter X.) However, certain comments are in order. First, to the extent that high school dropouts may have greater labor market disabilities than those students who continue in school, the earnings of the dropouts may understate the true opportunity costs of the last two years of schooling for those students who eventually graduate. Second, potential graduates are not wholly unemployed while attending high school, but this factor is not accounted for in the study. The result is to impart an upward bias to the opportunity cost measure. What the net effect of these two counteracting biases is is not clear. Finally, for the first year of senior high school, tenth grade, the assumption is that employment opportunities for this age group are so slight and at such low wages that opportunity costs can be effectively ignored. A downward bias in the total opportunity costs results to this, but it is most certain to be very small. Finally, earnings and not wage rates are being measured here so that the effect of unemployment is included in the opportunity cost measures to society. This constitutes a downward bias to the cost measure.

Incidental Costs. These costs represent the expenditures involved in attending school which are over and above the normal daily costs of maintenance for students, such as the costs of transportation to and from school. Again, the major emphasis of this study should be on marginal differences between different curricula and skills. In marginal terms, there is little reason to assume that such costs differ greatly among the students pursuing different curricula. Such costs can be ignored in this study since they will have little effect on marginal differences.

Job Search Costs. Job search costs are an important element in the area of investment in human resources. If job search costs are functionally related to the various educational curricula, then such costs should be attributed to the respective curricula or training skills. These marginal differences in job search costs can be estimated by determining the length of time it takes to find a job and multiplying this by the opportunity cost wage rate. Personal maintenance costs incurred in the job search which are over and above the ordinary should also be counted.

Job search costs in this final report are only imperfectly accounted for due to several reasons. First, extraordinary maintenance is ignored. However, there is no reason to assume marginal differences in extraordinary maintenance costs among curricula, so this is not necessarily a bias. Second, average wages are one of the measures of benefit. These average wages reflect the lack of earnings incurred during the initial job search period after high school graduation as well as job search costs during subsequent periods of unemployment. But since job costs incurred at the beginning of a benefit period are, in effect, spread over the entire period during which benefits are measured and averaged, the use of the discount factor will result in a downward biasing of these costs. And, finally, some students remained voluntarily out of the labor force for given periods after their graduation, whereupon they then entered the labor force and began their job search. Such periods of voluntary separation from the labor force should not be included in an estimate of the costs of the job search, since those persons who voluntarily withdraw from the labor force can be presumed to be receiving benefits while out of the labor force at least equal to their best alternative were they to enter the labor force. But the data in this study does not distinguish this fact and, therefore, job search costs will tend to be overestimated, or conversely, benefits will be underestimated. The net effect of these two counteracting biases is probably in the direction of underestimation since the numbers of those voluntarily not in the labor force immediately after graduation is not large. Chapter VIII presents estimations of job search costs.

On-the-Job Training Costs. While marginal costs are less to train academic graduates than vocational-technical graduates during the period of formal education, for the same or similar jobs and rates of pay, it may be that academic graduates require more on-the-job training. If this situation is a direct result of the type of training received in the school and not a result of socio-demographic characteristics between the two groups, then such costs should be attributed to the different curricula. However, it may be that the academic graduate has less mechanical aptitude than, say, the vocational-technical graduate, both of whom become machinists after graduation. If such is the case, then the fact that it costs more to train the academic graduate on the job is not due to the curriculum in question but to the characteristics of the graduate himself. In such a case, imputation of on-the-job training costs would bias social costs upward.

Interviews of major employers in each Standard Metropolitan Area for the three cities of the study have been conducted in an attempt to ascertain the nature of these costs. The findings are discussed in Chapter XIII.

C. Private Costs

Since this study deals with public school systems, there are no tuition costs with which to be concerned in estimating private costs of education. Indeed, much of the joint costing problem is avoided in the estimation of private costs. None of the current or capital costs incurred by the school systems needs to be considered as private costs. The other basic difference between private and social costs lies in the treatment of foregone earnings.

As indicated in Chapter III, when laws prohibit the labor force participation of students in certain age groups, no private opportunity costs should be imputed since students have no choice but to attend school. But to the extent that students are allowed labor force participation, earnings foregone by the student should be net of income and other taxes. In addition, an adjustment for unemployment must be made for these private opportunity costs, but not for social opportunity costs. For the latter case, one wishes to know what alternatives were foregone in a real sense--what society could have produced. A moment's reflection will indicate the arbitrariness of making an adjustment for unemployment for society when you try to estimate social opportunity costs of education in, say, 1932 as opposed to 1944.[8]

On-the-job training costs and job search costs should be net of income taxes. Incidental costs will be the same for the individual as for society, except that, for society, adjustments should be made for excise taxes if the traditional application of a cost correction factor is followed. Apart from this, techniques of estimation are similar between private and social costs.

D. Summary

1. All costs are fundamentally opportunity costs, the cost of foregoing the next best alternative when a given action is undertaken.

2. Distinctions should also be made between social, private and governmental costs.

3. Joint costs are a problem in the measurement of average but not marginal costs.

4. Joint cost problems occur at a given point in time when a process produces more than one unique output as well as through time when a flow of different outputs derives from a given capital input.

5. The use of the Capital Recovery Factor (CRF) is necessitated simply because a given capital input produces a flow of different outputs over time. If such were not the case, then the total cost of the capital input would simply be ascribed to a given output at the time the resources are actually committed.

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[8] See Mary Jean Bowman, "The Costing of Human Resource Development," in Robinson and Vaizey, editors, _op_. _cit_., p. 431. Also R. M. Haveman and John V. Krutilla, "Unemployment, Excess Capacity and Benefit-Cost Investment Criteria," _Review of Economics and Statistics_, August 1967.

6. The appeal to market prices in an effort to estimate the opportunity costs of resources already committed to education is a tenuous process at best. This effort at shadow pricing will most likely overestimate the value of those committed resources. However, no better alternative appears to exist at present.

CHAPTER VI

DESCRIPTION OF THE DATA

A. Introduction

The ideal data needs set forth in Chapter V cannot be perfectly fulfilled. As will become evident, there are many gaps in the social and private cost data presented below. Most of the cost data collected is generally structured on the basis presented in *Financial Accounting for Local and State School Systems: Handbook II*.[1]

B. Data Sources and Estimated Costs

Cost Data for City A. City A has published cross-section data on costs for the years covered by this study, namely, the fiscal years 1955-56 through 1959-60.[2] In fact, these cross-section data extend prior to the World War II period. Thus, time series data for the fiscal years 1946-47 through 1959-60 can be generated from these

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1. *Financial Accounting for Local and State School Systems: Handbook II*, *op. cit*.

2. The fiscal year in this case runs from January 1 through December 31 for each year. Thus, to make this data comparable to the cost data of the other two school districts as well as making it comparable to the benefit data, a moving average of the data was calculated for each year by combining successive pairs of calendar years and calculating their average.

cross-section data. However, the cross-section data are incomplete and in many cases it is impossible to determine exactly how a given variable reported in the data has been defined.

Up through fiscal year 1959-60, for each elementary, junior high, senior high and vocational-technical high school in the city, the following data are reported:[3]

I) Costs:

1) Separate salary figures reported for each of the staff groups in II below, for items 1), 2), and 3);

2) Textbook expenditures;

3) Costs of stationery and supplies used in instruction

4) Maintenance (repair to buildings and repairs and replacement of equipment);

5) Operation (fuel, light and power, custodial and other supplies, custodial, engineers' and window cleaners' salaries);

6) Total current expenses (the sum of all the foregoing costs); and,

7) The original construction costs of most of the school buildings and physical plant as well as most site acquisition costs and major addition or renovation costs, by school and year of construction or acquisition.

II) Physical Characteristics:

1) Number of principals;

2) Number of teachers (which includes classroom teachers, librarians, counselors, etc.);

3) Number of secretaries;

4) Average daily attendance; and,

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[3] After fiscal year 1959-60, City A no longer published cross-section data by school.

5) Average daily attendance by academic, general, trade preparatory and trade and industrial curricula.[4]

The school district is administered centrally and several elements of total cost have not been recorded at the school level, by year, but are recorded as a lump sum at the school district level. These are: certain costs of administration; insurance costs; attendance services; health services; fixed charges [much of which is wage payments such as social security; food services (of which the cost is partly borne by the students)]; student body activities; and, community services. Thus, total system costs for any given year are more complete for the system as a whole than they are by school within the system. However, since much of the above represents joint costs, they do not affect the determination of marginal costs between vocational-technical and comprehensive senior high schools.

Fortunately, since cross-section data exist by type of school, average current costs based on the above qualified data can be measured by vocational-technical and nonvocational-technical (academic, general, vocational-comprehensive) curriculum areas.[5] The vocational-technical curriculum is taught exclusively in vocational-technical senior high schools, while the other curricula are taught in comprehensive senior high schools. These costs are exclusive of site, physical plant, and equipment capital costs as well as the joint cost items listed above. These data are displayed for Cities A, B and C in Table 5.

Other current costs (also incomplete) exist by vocational-technical course for the fiscal years 1961-65 and 1966-67. Data for fiscal year 1965-66 were not obtainable. These costs include teachers' salaries and allowances for supplies, travel, guidance, equipment and supervision. Instructional salary and travel is identifiable by course but equipment and supplies costs are not.

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4. The trade preparatory curriculum is defined in this study as vocational-comprehensive. The trade and industrial curriculum is defined as vocational-technical. See Appendix II.

5. These average current costs are distinct from average total costs which would include capital costs. Neither the average current nor average total costs are precise since the joint cost problem affects the determination of both.

TABLE 5

CURRENT OPERATING EXPENSES/AVERAGE DAILY ATTENDANCE FOR SENIOR HIGH SCHOOLS IN CURRENT DOLLARS[a]

Fiscal Year	CITY A		CITY B		CITY C		
	Comprehensive	Vocational-Technical	Comprehensive	Vocational-Technical	Comprehensive	Vocational-Academic[c]	Vocational-Technical
46-47	212	274	217	415	194	119	198
47-48	239	291	280	613	246	151	250
48-49	262	308	318	697	264	155	250
49-50	282	311	309	797	278	166	256
50-51	277	316	320	900	314	200	320
51-52	340	368	349	868	338	187	328
52-53	363	404	351	925	356	175	362
53-54	395	402	378	1,039	363	175	375
54-55	400	471	379	857	380	192	391
55-56	404	489	388	919	405	231	440
56-57	431	528	421	985	420	210	414
57-58	462	587	425	989	429	263	360
58-59	442	607	430[b]	621[b]	444	246	386
59-60	517	702	397[b]	626[b]	498	268	426

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[a] See text for those cost items included and those excluded from current operating expenses. The use of average daily membership (ADM) or average daily enrollment (ADE) would yield smaller average current cost figures. The reader is cautioned against making unwarranted inter-city or inter-year comparisons of either "quality" or "costliness." These cost data in themselves imply nothing concerning economic efficiency. These figures are based on current operating expenses and ADA reported separately for each type of senior high school, by city, for the combined ADA of 10th, 11th, and 12th grade.

[b] These figures are based on estimated ADA.

[c] Graduates from this type of high school have, as defined in this study, a curriculum major in both the academic and the vocational-technical curriculum. See Appendix II.

Guidance costs tend to be joint in nature. Due to missing, or unreported data, only total current instructional salary can be allocated by course area. Marginal instructional costs can be estimated for broadly aggregated areas of T and I preparatory and Technical courses. These data are displayed in Chapter VII.

Some data exist on equipment costs by course area. These data are displayed in Table 6 for a single vocational-technical school of City A for fiscal 1967. As can be seen, these average capital costs vary appreciably.

Cost Data for City B. The quality and quantity of cost data in City B are considerably different from that in City A. Only incomplete cross-section data which report only salaries exist in City B as a function of separate senior high or vocational-technical school. These data are reported on an annual basis through 1957, so that they can be estimated on a fiscal basis only through 1956-57. The data are too fragmentary to be usable in cost analysis. Time series data exist for City B as a function of senior high and vocational-technical expenditures and extend from fiscal year 1946-47 through fiscal 1959-60. After 1959-60, expenditures for senior high and vocational-technical high schools are combined. At this point, insufficient structural data exist such as class size or differential enrollments, to facilitate the use of time series data extending beyond fiscal 1960. As shown in Chapter VII, no econometric cost analysis of this data could be performed.

The following data, then, exist in time series by year for City B for comprehensive and vocational-technical senior high schools:

I) Costs:

Current operating expenditures by fiscal year which include:

1) Administration costs;

2) Salaries of principals, teachers, supervisors, and other staff;

3) Text and library books and other educational supplies and expenses;

4) Auxiliary services such as health, pupil transportation or athletics;

5) Maintenance of plant, wages, supplies and contracted services;

TABLE 6

CAPITAL EQUIPMENT COSTS FOR SELECTED VOCATIONAL-TECHNICAL COURSES IN CITY A FOR 1966-67, IN CURRENT DOLLARS[a]

Course	Capital Costs[b]				Supply Costs
	CRF by Course		CRF by Course by Student Enrolled		
	i=10, n=5	i=10, n=10	i=10, n=5	i=10, n=10	
1. Auto Mechanics	$9,312	$5,743	$29	$18	$29
2. Auto Body and Fender	1,125	694	40	25	29
3. Commercial Art	893	551	13	8	39
4. Machine Shop	8,694	5,362	290	179	29
5. Sheet Metal	750	463	20	13	39
6. Welding	1,377	849	33	20	39
7. Quantity Food Occupations	54	34	0.88	0.54	39

[a] The data for 1 through 7 are based on capital equipment costs for newly constructed shops in only one vocational-technical school of City A. Student enrollments are based on records for that school only. The reader is cautioned against making economic efficiency comparisons between courses on the basis of these cost data alone.

[b] See equation (10) for the formula for the capital recovery factor; i is the interest rate used in discounting and n is the number of years the equipment is in use.

6) Operation of plant, both wages and supplies; and,

7) Fixed charges, a very small item.

II) Physical Characteristics:

1) Median class size by selected fiscal years;

2) Average daily attendance by fiscal year;[6] and,

3) Net roll (enrollment) by grades by fiscal year.

A substantial amount of under-reporting of allocable current costs occurs in these cost figures since the city directly bears many of the costs of running the school system, especially wage fringes and capital costs. These costs borne by the city, which amount to about one-third of total costs, are aggregated. Thus, those costs which were conceptually distributable among the schools in the system can no longer be distributed for practical reasons. At the cost of great expense and time cross-section data by school by fiscal year could be estimated from individual microfilmed vouchers which are scattered randomly among the vouchers of the entire city's set of microfilmed vouchers. Needless to say, such an effort was not possible for this study.

Average current (but incomplete) costs of training the vocational-technical and nonvocational-technical curricula can be estimated for most years for City B. These are displayed in Table 5. The deviations in current operating expenses/ADA for City B in fiscal years 1953-54 and 1954-55 are due to fairly sharp changes in both current operating expenses and ADA for those years. Current costs by selected skill areas are estimated for City B for the fiscal year 1966-67. These are displayed in Tables 7 and 8.

Cost Data for City C. The current cost data for City C are the most complete and usable for the three cities in the study. Cross-section data by type of school on current operating costs were gathered for each senior high school in the city for the fiscal years 1955-56 through 1961-62. In addition, fiscal year cross-section data on such factors as median and average class size, teacher quality and curriculum composition exist for each senior high school for all the post-war years to the present. The following data, then, exist by

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[6] Available through fiscal 1957-58, only. ADA for fiscals 1959 and 1960 are estimated.

TABLE 7

COST OF TRAINING FOR SELECTED VOCATIONAL-TECHNICAL COURSES IN CITY B FOR 1966-67[a]

Course	Student Enrollment	Teaching Salary Cost Per Student Enrolled	Capital Costs	
			CRF by Course[b]	
			i=10, n=5	i=10, n=10
Auto Mechanic[c]	199	180		
Brick Masonry[c]	30	667		
Clerical Work[c]	15,690	35		
Commercial Art	51	184		
Commercial Baking	43	407	32	20
Cosmetology[c]	174	113		
Dressmaking and Tailoring[c]	317	169		
Dry Cleaning	29	310		
Electrical Construction[c]	235	84		
Industrial Electronics	185	125	1,385	853
Machine Shop	124	441	4,516	2,796
Mechanical Drafting	563	126	56	34
Painting	13	2,262		
Plumbing and Heating[e]	320		16	10
Printing[c]	298	153		
Radio and T.V.	83	118	34	21
Sheet Metal[d]	12	750	699	431
Shoe Repair	8	1,006		
Stenography[c]	2,723	146		
Welding	26	571		
Woodworking	110	318	443	273

[a] These costs and underlying enrollment data refer only to City B. Capital equipment costs are based on an inventory of all shop equipment valued at $20 per item or more. These inventory valuations are based on historical cost. The reader is cautioned against making economic efficiency comparisons between courses on the basis of these cost data alone.

[b] See equation (10) for the formula for the capital recovery factor; i is the interest rate used in discounting and n is the number of years the equipment is in use. These are equipment costs only.

[c] Capital equipment costs are not available.

[d] Estimates based on 1965-66 enrollment.

[e] Teaching salary costs not available. Enrollment is for 1965-66.

TABLE 8

CAPITAL EQUIPMENT COSTS FOR SELECTED VOCATIONAL-TECHNICAL COURSES IN CITY B FOR 1966-67 BY STUDENT ENROLLED[a]

Course	Capital Costs[b]	
	i=10, n=5	i=10, n=10
Industrial Electricity	7.49	4.61
Commercial Baking	.74	.47
Machine Shop	36.42	22.55
Mechanical Drafting	.10	.06
Plumbing and Heating[c]	.05	.03
Radio-Television	.41	.25
Sheetmetal Work[c]	58.30	35.92
Woodworking	4.03	2.48

[a] Capital equipment costs are based on an inventory of all shop equipment valued at $20 per item or more. These inventory valuations are based on original cost. The reader is cautioned against making economic efficiency comparisons between courses on the basis of these cost data alone.

[b] See equation (10) for the formula for the capital recovery factor; i is the interest rate used in discounting and n is the number of years the equipment is in use. These are equipment costs only.

[c] Estimates based on 1965-66 enrollment.

school for three types of senior high school in the city, vocational-technical, vocational-academic and comprehensive:[7]

I) Costs:

1) Principal salaries;

2) Teacher salaries;

3) Supervision and clerical salaries;

4) Educational supplies;

5) Free text and library books;

6) Other instructional expenses;

7) Operation;

8) Maintenance;

9) Administration;

10) Fixed charges;

11) Other services; and,

12) Capital outlay.

II) Physical Characteristics:

1) Enrollment by grade, for selected months;

2) Median and average class size for selected months;

3) Size distribution of classes, by course area, for selected months;

4) Size distribution of teachers' salaries by teacher qualification;

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[7] The vocational-academic senior high school, as defined in this study, essentially is a pre-engineering high school which produces graduates having both an academic and a vocational-technical curriculum major. All three types of schools provide specialization in the vocational-technical curriculum, though the relative numbers of graduates in this curriculum differ. See Appendix II.

5) Average daily attendance and average daily membership;

6) Number of teachers; and,

7) Number of classes.

However, apart from possible errors and omissions, the cost figures by type of school do not represent a complete enumeration of total outlays, since again, some operation, maintenance, capital outlay, fixed charges and other services are accounted for centrally. Even when these costs are not conceptually of the joint cost nature, they are no longer allocable. Thus, while costs directly associated with instruction are almost totally accounted for, only about 50 percent of maintenance costs are accounted for on a per school basis. Since the major element of total costs is instructional costs, this does not represent an insurmountable bias.

Foregone Earnings. The estimation of both private and social foregone earnings which occur as a result of high school attendance is very difficult. However, in this study the following estimations are made. Earnings and employment data on both graduates and dropouts have been collected. The dropouts have left school anywhere from a few months to more than a year before the students in their time cohort ultimately graduated.[8] Thus, it is possible to estimate for the 12th and, less accurately, for the 11th and 10th grades, the differences in earnings between those students who dropped out of the vocational-technical high school and those students who are comprehensive high school dropouts. The differences in these earnings would represent an estimate of the differential opportunity costs involved in attending a vocational-technical as opposed to a comprehensive senior high school.

Table 58 displays the estimated results. As can be seen, for each of the three cities in the study, there are no statistically significant differences in the before tax average monthly earnings in the period prior to projected graduation between the dropouts of the comprehensive and vocational-technical senior high schools. Thus, such opportunity costs to the 11th and 12th grades of the eventual graduates will not be imputed in this study.

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[8] For the sample, the average length of time for having dropped out is 12 months, with a standard deviation of six months.

C. Social and Private Benefits

Labor Market Benefits. As previously indicated, this study is conducted in terms of money measures of costs and benefits. But such measures are incomplete. Ideally, benefits and costs should be measured in terms of utility gained or foregone as a result of pursuing a given activity relative to pursuing some alternative activity. But, given the state of economic science, utility is not directly measurable. Thus, money costs and other measures become indices for the utility gained or lost. As a result, many aspects of benefit or cost, such as psychological pleasure or pain, remain unmeasured.

In addition, any benefit or cost element which occurs outside of the market mechanism may fail to get measured so that even the money measures of this study, as money measures, may be incomplete. This is the familiar problem of external economies and diseconomies. Such external economies and diseconomies should be considered and their probable impact on the benefit-cost analysis described. However, one should use restraint in listing such externalities since the search for such external effects has no logical end. Finally, it is quite easy to begin double counting as different aspects of any action begin to have overlapping effects. Even when not dealing with externalities, whose impacts and dimensions may be vague, one must beware of double counting. Thus, one must not count as a benefit both the increased earnings of a graduate and the increased productivity of a graduate, since increased earnings are a direct result of increased productivity.

Given the above warnings, then, this study relies upon two indices of benefit. It assumes that money earnings and the percent of time employed out of total time which could be devoted to civilian labor force participation are appropriate indices to measure the social and private benefits of education. In short, the assertion is that one of the major objectives of education is to improve economic efficiency and economic welfare. And, it is further asserted that money earnings and employment are appropriate indices by which to measure such welfare. The employment index is the same for both private and social measurement. Private earnings should be net of taxes, social, gross.

Both employment and earnings are based on the labor market histories reported by mail questionnaires from a sample of high school graduates from the classes of June and January 1959 and 1960. The labor market histories are measured for a six-year period following graduation. Appendix I displays the questionnaire used.

Two major methodological considerations should be noted. First, only civilian labor force participation is considered as relevant for the purposes of this study. Thus, any time spent in the military labor force is excluded from the analysis. The costs of dealing with the methodological problems of including military labor force experience in a study of this nature far outweigh the benefits to be gained by doing so. Second, no imputation of economic benefit is made during those periods when a person is voluntarily not in the civilian labor force. This follows the current practice used in the national income accounts. Clearly, however, one can theoretically argue that the economic benefits one gains when he is voluntarily out of the labor force are at least as great as his best alternative if he were to enter the labor force. Since it is not clear what this best alternative is, however, it was decided not to make such an imputation. As will be seen in Chapter VIII, there is very little difference in voluntary non-labor force experience between the different curricula, so that, in terms of absolute earnings differentials, the lack of imputation of non-labor force benefits has not created a major bias in the study.

Non-monetary Benefits. Non-monetary benefits are divided into two types. First are those benefits which relate specifically to the job environment such as whether or not a graduate received a training related job. An index of benefit of this nature is partially accounted for in the economic variables measuring employment and earnings, assuming that, other things equal, people with training related jobs will tend to have higher earnings and more stable employment. Non-economic benefits of both a private and social nature are gained from the fact that a person is able to employ the skills he has learned in a job related to his training. Such things as greater job satisfaction and better morale and well-being represent an increase to the total utility to be gained from the training and educational experience. The following variables represent a measure of both economic and non-economic benefit:

1) Training relatedness of the job or jobs held;

2) Overall career relatedness of the job or jobs held; and,

3) Whether or not knowledge of the job or jobs came mainly from the high school or from some type of on-the-job experience.

The second measure of non-economic benefit deals with the socialization effects of education. Non-economic variables which are indices of the socialization goal of education have been measured. These are three:

1) The number of clubs or organizations of which the graduate is a member at the time he was interviewed;

2) Whether or not the graduate voted in the 1966 primary elections; and,

3) Whether or not the graduate voted in the 1964 presidential election.

Chapter XI presents the analysis of these non-economic benefits.

D. Characteristics of the Study Sample

As indicated before, there are five curricula included in the study. These are academic or college preparatory, general, vocational-academic, vocational-comprehensive and vocational-technical. Appendix VI to this study indicates the definitions of each of the five curricula.

The sample design has the following structure. First, every vocational-technical or vocational-academic graduate in each of the three cities was sampled by the mail questionnaire while only one in four of the other three curricula was sampled.

The types of curriculum comprise one of the seven sets of independent variables in this study. The main concern of this study is a comparison between the academic and the vocational-technical curricula. However, in the cost-benefit analysis of Chapter IX, comparisons must be made between the combined nonvocational-technical curricula of the comprehensive senior high schools and the vocational-technical curriculum of the vocational-technical senior high schools.

Note that while comparisons are made between these curriculum groups after controlling for relevant socio-demographic and other variables, no claim is made that any one of these groups is a theoretically unique control group for any one of the others. It is also quite clear that the independent variables used in this study do not effectively account for all of the differences between the five curriculum groups. And, certainly, the regression analysis does not control perfectly for the differing patterns of interaction among the socio-demographic variables either within or among curriculum groups.

Other Independent Variables. Of the remaining six sets of independent variables, certain of these variables need little or no theoretical explanation. These are age, sex, race, and marital status. Age does not enter into the regression models directly since the graduates were of very similar age upon graduation. Since the deviations within the sample with respect to age are small, it is not worthwhile to include age as an independent variable in the regression analysis.

The variable set for city of graduation is introduced to control not only for differences in the educational institutional structure among the three cities, but also to represent differing industrial and labor market structures, price level and employment differentials, and region.

The use of IQ measures represents a major empirical addition to studies of this nature. However, this variable tends to interact with college attendance and father's education. Appendix III describes the measures of IQ used in the three cities of this study.

Finally, father's education is introduced as a measure of socio-economic status and background. Father's education correlates highly with father's occupation, income, and social status. It also correlates with the educational and occupational attainment of the child. The characteristics of the sample are displayed in Tables 9 and 10.

The total sample size is limited to 1255 due to the fact that respondents returned incomplete questionnaires in many cases. The necessity of having to collate different types of data for each respondent resulted in a further reduction in sample size. The total sample size is further limited by the fact that all graduates who attended any type of college were excluded from the analysis. Appendix IV describes the test for the differences between those who responded to the mail questionnaire and those who did not respond and who were subsequently interviewed by personal contact.

The structure of the sample as a function of sex, race and curriculum is self-explanatory. Looking at Table 9 one sees that females predominate against males and whites predominate against nonwhites. The average IQ of males is 101.8 and that of females, 104.4. Table 10 shows that the average IQ of white males is 102.6 and of nonwhite males, 93.9. The average IQ of white females is 105.5 and of nonwhite females, 97.0. Whites have an average IQ of 104.7 and nonwhites, 96.4. The average IQs of the graduates from the academic and vocational-academic curricula are quite similar, 108.5 and 108.1, respectively. The average IQ of the graduates from the vocational-technical curriculum is 102.0, and is only higher than that for general curriculum graduates.

With respect to father's education, the pattern is similar. The fathers of females and whites have higher average educations than those of males or nonwhites. The fathers of vocational-technical graduates have the lowest average number of years of schooling completed, 8.9. Fathers of vocational-academic graduates have the highest average number of years of schooling completed, 11.4.

TABLE 9

CURRICULUM AS A FUNCTION OF SEX AND RACE, SEX AND IQ, AND SEX AND FATHER'S EDUCATION, NON-COLLEGE ATTENDING SAMPLE

Variable	Vocational-Academic		Vocational-Comprehensive		General		Vocational-Technical		Academic		Total or Average	
	#	%	#	%	#	%	#	%	#	%	#	%
Male												
White	7	87.5	46	93.9	54	93.1	119	86.9	65	92.9	291	90.4
Nonwhite	1	12.5	3	6.1	4	6.9	18	13.1	5	7.1	31	9.6
Female												
White	35	92.1	197	82.8	57	89.1	371	86.7	148	89.7	808	86.6
Nonwhite	3	7.9	41	17.2	7	10.9	57	13.3	17	10.3	125	13.4
IQ												
Male	112.6[a] (8.7) 8		98.9 (11.2) 49		100.5 (10.1) 58		99.8 (10.2) 136		107.4 (11.2) 71		101.8 (11.1) 322	
Female	107.2 (7.3) 38		104.4 (11.1) 238		101.9 (12.5) 64		102.7 (10.1) 428		108.9 (11.6) 165		104.4 (10.9) 933	
Average	108.1 (7.7) 46		103.5 (11.3) 287		101.2 (11.4) 122		102.0 (10.1) 564		108.5 (11.5) 236		103.7 (11.0) 1,255	
Father's Education[b]												
Male	10.8 (4.2)		9.8 (3.3)		8.9 (3.1)		8.6 (2.6)		9.9 (3.2)		9.2 (3.2)	
Female	11.5 (2.0)		9.7 (2.7)		10.0 (3.3)		9.0 (2.9)		10.6 (3.2)		9.7 (3.0)	
Average	11.4 (2.5)		9.7 (2.8)		9.5 (3.2)		8.9 (2.8)		10.3 (3.2)		9.5 (3.0)	

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[a] In descending order, the statistics are the group mean, the standard deviation of the group mean, and the number of observations per group.

[b] The number of observations per group is the same as for IQ.

TABLE 10

SEX AS A FUNCTION OF RACE AND IQ AND RACE AND FATHER'S EDUCATION, NON-COLLEGE ATTENDING SAMPLE

Sex	Father's Education		IQ	
	White	Nonwhite	White	Nonwhite
Male	9.3[a] (3.0) 291	8.0 (3.1) 31	102.6[b] (10.7)	93.9 (11.6)
Female	9.8 (2.9) 808	8.8 (3.1) 125	105.5 (10.5)	97.0 (10.6)
Average	9.7 (2.9) 1,099	8.7 (3.1) 156	104.7 (10.6)	96.4 (10.9)

[a] In descending order, the statistics are the group mean, the standard deviation of the group mean, and the number of observations per group.

[b] The number of observations per group is the same as for Father's Education.

E. Benefits as a Function of the Socio-Demographic Variables

A description of the broad characteristics of the benefit data is in order prior to a discussion of the regression analysis. Tables 11 through 15 show the relationship between the various measures of benefit and the independent variables considered in the study. These are gross relationships; after controlling for the influence of the other socio-demographic variables, the net relations for each of these independent variables may change as well as the pattern and level of statistical significance.

As the data of Table 11 show, the earnings and employment relationship as a function of sex and race are consistent with other labor market studies. Males earn more than females and are also employed more. Males average $444 per month over the six-year post-graduation period while females earn only $250. Males are employed 92.4 percent of the time, on the average, over the six-year period after high school graduation while females are only employed about 72.8 percent of the time.

The differences in earnings and employment between the three cities are due to a variety of factors. These differences are of interest only to the extent that differential educational costs between the cities exist.

Tables 12 and 13 display earnings and employment experience with respect to the graduates of the five senior high school curricula. The main interest of this study lies in comparisons between the vocational-technical graduate and the academic graduate. With respect to the average of time employed over the six-year post-graduation period, the sample of vocational-technical graduates is employed 79.7 percent while non-college attending academic graduates are employed 73.7 percent of the time. In fact, of the five curricula, the academic graduate is employed the smallest proportion of the time. The employment differences between the vocational-technical, vocational-academic, and general curricula are small over the six-year period as a whole.

It is interesting to note that female vocational-technical graduates are employed more over the six-year period, 75.5 percent, than are academic females, 66.3 percent. Academic males are employed less over the six-year period, 90.9 percent, than are vocational-technical men, 93.0 percent.

Of interest is the change in employment patterns for the graduates of the vocational-technical and academic curricula between the first and sixth years after graduation. There is approximately a ten percentage point difference in employment in favor of vocational-technical males for the first year after graduation. But

TABLE 11

THE RELATIONSHIP BETWEEN SELECTED SOCIO-DEMOGRAPHIC VARIABLES AND THE PERCENT OF TIME EMPLOYED AND AVERAGE MONTHLY BEFORE TAX EARNINGS, IN DOLLARS, DURING THE POST-GRADUATION PERIOD[a]

Variable	% of Time Employed: Six Year Average	% of Time Employed: First Year	% of Time Employed: Sixth Year	Average Monthly Before Tax Earnings: Six Year Average	Average Monthly Before Tax Earnings: First Year	Average Monthly Before Tax Earnings: Sixth Year
Total Sample N=1,255	77.9 (26.4)	80.3 (29.9)	67.0 (44.7)	300 (164)	258 (142)	299 (241)
Sex						
Male 322[b]	92.4[c] (13.8)	82.1 (27.5)	96.8 (15.3)	444 (165)	316 (180)	536 (194)
Female 933	72.8 (27.8)	79.7 (30.7)	56.7 (46.9)	250 (132)	238 (120)	217 (197)
Race						
White 1,099	78.4 (26.1)	82.9 (27.6)	65.3 (45.3)	309 (168)	272 (140)	300 (249)
Nonwhite 156	73.8 (27.7)	62.0 (38.4)	78.7 (38.3)	234 (120)	158 (118)	286 (171)
IQ						
Low: 89 or Less 123	79.9 (26.7)	72.7 (34.9)	80.8 (38.0)	297 (170)	222 (149)	346 (224)
Average: 90-110 818	77.7 (26.1)	80.7 (28.6)	65.5 (45.0)	297 (162)	258 (135)	289 (240)
High: 111 or More 314	78.1 (27.0)	82.4 (30.8)	65.4 (45.6)	309 (169)	272 (155)	304 (248)
City						
A 648	79.4 (25.6)	83.1 (28.0)	66.6 (44.8)	298 (160)	264 (140)	287 (236)
B 314	78.2 (25.7)	80.8 (29.4)	69.5 (44.4)	305 (170)	263 (146)	306 (230)
C 293	74.1 (28.5)	73.7 (33.5)	65.1 (45.0)	299 (169)	237 (143)	316 (262)

[a] The respondents in this study were graduates of January or June 1959 or 1960. Thus, individual members may have entered the labor market as much as 18 months apart. Variables introduced in subsequent regression analysis indicate that this factor is not statistically significant at the .05 level of significance. This qualification applies to the remainder of the tabular analysis in this chapter.

[b] The numbers below each socio-demographic characteristic are the sample sizes of the characteristic in question.

[c] In descending order, the statistics are the group mean and the standard deviation of the group mean.

TABLE 12

THE RELATIONSHIP BETWEEN SECONDARY CURRICULUM AND PERCENT OF TIME EMPLOYED DURING THE SIX-YEAR POST-GRADUATION PERIOD, BY SEX

Curriculum	% of Time Employed Over the Six-Year Post-Graduation Period[a]			% of Time Employed in the First Year After Graduation			% of Time Employed in the Sixth Year After Graduation		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Vocational-Academic	87.9[b] (16.7) 8	77.3 (25.2) 38	79.1 (24.1) 46	84.4[c] (16.3)	75.4 (28.5)	77.0 (26.9)	91.7 (23.6)	63.2 (43.4)	68.1 (41.9)
Vocational-Comprehensive	94.9 (9.5) 49	73.0 (28.0) 238	76.1 (27.1) 287	85.5 (20.1)	83.3 (27.3)	83.7 (26.2)	96.8 (15.3)	53.6 (47.2)	61.0 (46.4)
General	91.6 (18.6) 58	68.7 (26.9) 64	79.6 (25.9) 122	81.3 (29.8)	75.1 (32.5)	78.1 (31.3)	95.4 (19.1)	47.0 (47.0)	70.0 (43.7)
Vocational-Technical	93.0 (12.9) 136	75.5 (26.9) 428	79.7 (25.4) 564	84.6 (25.9)	82.9 (28.5)	83.3 (27.9)	97.7 (11.8)	62.6 (46.1)	71.1 (43.3)
Academic	90.9 (13.1) 71	66.3 (29.3) 165	73.7 (27.9) 236	75.2 (32.9)	69.2 (37.5)	71.0 (36.2)	96.9 (16.7)	48.2 (47.3)	62.9 (46.4)
Total	92.4 (13.8) 322	72.8 (27.8) 933	77.9 (26.4) 1,255	82.1 (27.5)	79.7 (30.7)	80.3 (29.9)	96.8 (15.3)	56.7 (46.9)	67.0 (44.7)

[a] The year is estimated from the point of time at which a student graduates. Thus, some of the respondents may have entered the labor market as much as 18 months ahead of others. See Table 11.

[b] In descending order, these statistics are the group mean, the standard deviation of the group mean, and the number of observations per group.

[c] Number of observations is not repeated since these are constant for all the subsequent indices displayed in this table.

TABLE 13

THE RELATIONSHIP BETWEEN SECONDARY CURRICULUM AND AVERAGE MONTHLY BEFORE TAX EARNINGS DURING THE SIX-YEAR POST-GRADUATION PERIOD, BY SEX, IN DOLLARS

Curriculum	Average Monthly Before Tax Earnings Over the Six-Year Post-Graduation Period[a]			Average Monthly Before Tax Earnings for the First Year After Graduation			Average Monthly Before Tax Earnings for the Sixth Year After Graduation		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Vocational-Academic	419[b]	292	315	324[c]	239	254	482	274	310
	(172)	(136)	(149)	(161)	(120)	(130)	(192)	(206)	(216)
	8	38	46						
Vocational-Comprehensive	476	243	283	354	248	264	556	191	253
	(181)	(120)	(158)	(175)	(106)	(127)	(217)	(186)	(235)
	49	238	287						
General	434	228	326	315	210	260	533	179	347
	(165)	(122)	(177)	(180)	(110)	(156)	(203)	(209)	(271)
	58	64	122						
Vocational-Technical	453	264	309	327	250	268	549	243	317
	(169)	(136)	(165)	(184)	(121)	(143)	(199)	(195)	(236)
	136	428	564						
Academic	417	223	282	269	204	224	506	188	283
	(142)	(135)	(163)	(175)	(133)	(149)	(158)	(202)	(239)
	71	165	236						
Total	444	250	300	316	238	258	536	217	299
	(165)	(132)	(164)	(180)	(120)	(142)	(194)	(197)	(241)
	322	933	1,255						

[a] The year is estimated from the point of time at which a student graduates. Thus, some of the respondents may have entered the labor market as much as 18 months ahead of others. None of these dollar figures is deflated. See Table 11.

[b] In descending order, these statistics are the group mean, the standard deviation of the group mean, and the number of observations per group.

[c] Number of observations is not repeated since these are constant for all subsequent measures displayed in this table.

this difference between the males all but disappears by the sixth year. However, the disparity in employment between females of the two curricula widens from 12.3 percentage points to 14.4 percentage points between the first and the sixth years. Employment increases over time for the males of the two curricula and decreases for the females.

The difference in employment between the sexes as a whole is very small, 2.4 percentage points, for the first year after graduation. By the sixth year, men are employed 96.8 percent of the time while women are employed only 56.7 percent of the time. When one considers that the sixth year after high school graduation represents a period of the prime child-bearing years, when the women are about 24 years of age, this disparity in employment rates is not at all surprising.

An interesting picture exists with respect to race. Whites are employed only 65.3 percent of the time in the sixth year after graduation while nonwhites are employed 78.7 percent of the time. The reason for this disparity in employment experience lies in the sex-race composition of the sample. More whites than nonwhites are in the sample and more females than males. For the economy as a whole, the labor force participation of white females is considerably lower than the labor force participation of nonwhite males and, especially, nonwhite females, which helps explain the higher level of employment for nonwhites.

With respect to IQ, (Table 11) the percent of time employed over the six-year post-graduation period is 79.9, 77.7 and 78.1 percent for low, average and high IQ graduates, respectively. For the sixth year after graduation low IQ graduates earn higher average monthly earnings than high IQ graduates, $346 per month versus $304 per month, respectively. But for the six-year average, high IQ graduates earn more, $309 per month, than low IQ graduates, $297 per month. In addition, as will be seen in the regression analysis in Chapter VIII, the net effect of IQ on earnings is usually statistically significant. As shown in Table 12, total employment drops 12.2 percentage points for vocational-technical graduates and by 8.1 percentage points for academic graduates over the six-year period. These changes are sex-related. The graduates of the vocational-academic, general, and the vocational-comprehensive curricula also suffer a drop in employment.

The difference between male academic and male vocational-technical graduates over the six-year period in terms of earnings is large; the two groups earn $453 and $417 per month, respectively. Female vocational-technical graduates also earn considerably more than female academic graduates for the six-year period, $264 per month versus only $223. The male vocational-comprehensive curriculum graduate earns the highest average monthly earnings over the six-year period. However, as a group, the general curriculum graduate earns the highest amount per month over the six-year period, $326. Vocational-technical graduates earn only $309 per month, and academic graduates only $282 per month over the six-year period.

Four curricula experienced earnings gains over the six-year period. In general, this should be expected since economic conditions improved considerably between 1959-1960 and 1965-1966. However, the rate of change in earnings and employment of the graduates among the various curricula is of major interest and should be related to the economic rationality of investing in training in the various curricula. This aspect is discussed in Chapter VIII. Academic graduates increased their average monthly earnings between the first and sixth years after graduation by about $59. Vocational-technical graduates increased their earnings by $49. General and vocational-academic graduates increased their average monthly earnings by $87 and $56, respectively. There was a drop of $11 for the vocational-comprehensive graduate.

The earnings of all male graduates are similar across the five curricula. Average monthly earnings for males over the six-year period range from $549 for vocational-technical graduates to a low of $482 per month for vocational-academic graduates. Vocational-academic females have the highest average monthly earnings in the sixth year after graduation, $274, but their numbers are small, 9, and the standard error is very large, 206. Thus, two-thirds (6) of these women have earnings which lie in a range from $480 per month to $66 per month. The next highest female earnings are $243 per month for vocational-technical graduates as contrasted with only $188 per month in the sixth year for academic females. In summary, it can be generally said that in terms of employment and money earnings, non-college attending vocational-technical graduates on the average fare better than non-college attending academic graduates over the six-year period. This occurs even though vocational-technical employment drops more over the six-year period in percentage point terms than that of the academic graduates.

Employment and Earnings by Vocational Skill. Tables 14 and 15 describe the employment and earnings experience of graduates of selected course specialities of the vocational-technical, vocational-academic and vocational-comprehensive curricula.

Certain characteristics of Table 14 stand out. First, with respect to employment, the effect of female sex shows clearly for the commercial-business, cloth fabrication, distributive education, and personal service courses. That is, the percentage of employment declines radically over time. Next, students taking courses associated with manufacturing employment, such as agricultural and horticultural, tool design, woodworking, and mechanical and repair, have the highest amount of employment in the sixth year after

TABLE 14

THE RELATIONSHIP FOR VOCATIONAL-TECHNICAL AND VOCATIONAL-ACADEMIC GRADUATES BETWEEN SELECTED COURSE SPECIALTIES AND THE PERCENT OF TIME EMPLOYED AND AVERAGE MONTHLY BEFORE TAX EARNINGS, IN DOLLARS, DURING THE POST-GRADUATION PERIOD

Course Specialty[a]	% of Time Employed: Six Year Average	% of Time Employed: First Year	% of Time Employed: Sixth Year	Average Monthly Before Tax Earnings: Six Year Average	Average Monthly Before Tax Earnings: First Year	Average Monthly Before Tax Earnings: Sixth Year
Commercial-Business	77.3[b] (26.3) 410	83.2 (27.4)	63.8 (45.5)	278 (139)	259 (121)	255 (200)
Food Service	80.8 (29.3) 17	61.3 (46.6)	87.3 (33.0)	301 (157)	170 (138)	367 (200)
Building Trades	98.6 (1.7) 5	91.7 (10.2)	100.0 (0.0)	429 (264)	327 (183)	482 (265)
Mechanical and Repair	93.5 (9.7) 26	80.1 (29.4)	99.4 (3.3)	432 (98.3)	272 (133)	554 (128)
Tool Design	94.5 (8.6) 23	88.4 (19.3)	100.0 (0.0)	519 (176)	422 (222)	603 (216)
Woodworking	96.1 (4.5) 10	85.0 (15.1)	98.3 (3.5)	471 (214)	321 (164)	546 (245)
Cloth Fabrication	67.1 (26.2) 11	87.1 (21.9)	43.9 (47.3)	223 (183)	243 (109)	180 (266)
Electrical and Electronic	91.0 (17.3) 22	83.3 (28.4)	94.3 (18.8)	433 (176)	335 (211)	503 (189)
Agricultural and Horticultural	95.8 (2.0) 2	75.0 (11.7)	100.0 (0.0)	577 (243)	452 (235)	659 (325)
Distributive Education	73.2 (28.4) 5	96.7 (4.5)	50.0 (50.0)	206 (84.6)	236 (27.3)	176 (179)
Personal Service	63.5 (28.8) 20	83.3 (33.6)	55.9 (48.1)	167 (89.8)	189 (95.7)	186 (169)

TABLE 14--Continued

Course Specialty[a]	% of Time Employed: Six Year Average	% of Time Employed: First Year	% of Time Employed: Sixth Year	Average Monthly Before Tax Earnings: Six Year Average	Average Monthly Before Tax Earnings: First Year	Average Monthly Before Tax Earnings: Sixth Year
Other	84.1 (21.8) 54	83.3 (28.2)	84.4 (35.3)	383 (173)	276 (164)	460 (252)

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[a] Five students had no course specialties. The course specialties are comprised of the individual courses listed below.

Commercial-Business Occupations: Data Processing, Stenography, Typing and Clerical;

Food Service Occupations: Restaurant Practice, Food Merchandising, Home Economics-Vocational, Baking;

Building Trades Occupations: Sheet Metal, Painting, Paperhanging, Decorating, Plumbing, Trowel Trades, Carpentry;

Mechanical and Repair Occupations: Airframe and Power Plant Mechanic, Automotive Maintenance, Air Conditioning, Heat and Refrigeration, Welding, Gas and Electric;

Tool Design Occupations: Foundry Practice, Machine Construction, Machine Design and Drafting;

Woodworking Occupations: Patternmaking (wood), Carpentry and Cabinetmaking, Cabinetmaking and Millwork;

Cloth Fabrication Occupations: Slipcover and Drapery, Upholstery, Tailoring, Dressmaking, Power Sewing Machine Operation;

Electrical and Electronic Occupations: Instrumentation, Electronics, Industrial Electricity, Radio and Television;

Agricultural and Horticultural Occupations;

Distributive Education and Selling Occupations;

Personal Service Occupations: Beauty Culture, Practical Nursing, Child Care, Dry Cleaning; and,

Other Professional and Semi-Professional Skilled and Semi-skilled Occupations: Music, Dental Assistant, Industrial Chemistry, Commercial Art, Textiles, Metallurgy, Architectural Drafting, Printing, Optical Mechanics, Shoe Repair.

[b] In descending order, these statistics are the group mean or percentage, the standard deviation of the group mean or percentage, and the number of observations per group. The number of observations is recorded only once since the number is the same for any given course specialty.

TABLE 15

THE RELATIONSHIP FOR VOCATIONAL-COMPREHENSIVE GRADUATES BETWEEN SELECTED COURSE SPECIALTIES AND THE PERCENT OF TIME EMPLOYED AND AVERAGE MONTHLY BEFORE TAX EARNINGS, IN DOLLARS, DURING THE POST-GRADUATION PERIOD

Employment or Earnings	Course Specialty: Vocational-Comprehensive Graduates[a]				
	Commercial-Business	Mechanical and Repair	Tool Design	Distributive Education	Other
% of Time Employed: Six Year Average	73.6[b] (28.1) 241	95.8 (5.0) 3	96.5 (5.2) 7	88.9 (17.1) 10	92.7 (11.9) 24
% of Time Employed: First Year	83.8 (27.3)	88.9 (9.6)	91.7 (11.8)	83.3 (21.5)	79.5 (21.4)
% of Time Employed: Sixth Year	55.3 (47.4)	88.9 (19.2)	100.0 (0.0)	75.0 (42.5)	93.8 (17.1)
Average Monthly Before Tax Earnings: Six Year Average	252 (129)	398 (205)	498 (164)	366 (235)	464 (202)
Average Monthly Before Tax Earnings: First Year	252 (114)	325 (191)	290 (92.2)	345 (233)	330 (166)
Average Monthly Before Tax Earnings: Sixth Year	205 (199)	416 (206)	640 (175)	363 (293)	536 (250)

[a] Two students had no course specialties. See Table 14 for the courses included in each of the course specialties listed. Course specialties with less than two observations were omitted from this table.

[b] In descending order, these statistics are the group mean or percentage, the standard deviation of the group mean or percentage and number of observations in the group. The number of observations is recorded only once since the number is the same for any given course specialty.

graduation. With respect to earnings, graduates of these four course areas report the highest average monthly earnings in the sixth year, ranging from $546 to $659 per month. In contrast, the cloth fabrication, personal service, and distributive education courses report average monthly earnings below $200 for the sixth year after graduation. How much of this differential is due to the fact that persons may be in the labor force but working part-time for voluntary reasons is not known. But, to the extent that voluntary part-time work occurs, total social or private benefits are underestimated.

Finally, these measured benefits should be qualified by the fact that it is not always the case that a person trained in a given course area obtains a job which is uniquely related to that area. In such cases it is not altogether clear what the measured benefit of the training should be, apart from its contribution to one's acquisition of general skills and abilities which the other curricula can also provide.

It is possible to make comparisons only for the commercial-business course between the graduates of the vocational-technical and vocational-academic and the vocational-comprehensive curricula. In terms of both earnings and employment, the vocational-comprehensive curriculum performs more poorly. The vocational-comprehensive graduate in commercial-business earns $252 per month on the average over the six-year period and is employed 73.6 percent of the time. The vocational-technical and vocational-academic graduate in commercial-business earns an average of $278 and is employed 77.3 percent of the time. These differences in performance could be due to differences in the nature of the course instruction, or any number of socio-demographic or labor market behavioral characteristics among the graduates themselves.

F. Summary

1. While it is generally agreed that in conceptual terms benefits are more difficult to measure than costs, for the indices of benefit and cost chosen in this study, benefit measures pose fewer shortcomings than cost measures.

2. With respect to cost data, aggregation, under-reporting, and lack of data collection in the three cities, the cost measures of this report are subject to revision as new evidence is discovered.

3. No judgments as to relative economic efficiency either between cities, over time, or among courses can be made

based on a simple inspection of the cost data alone or the benefit data alone.

4. The sample of high school graduates is highly weighted toward females. Other things equal, this will tend to lower the absolute level of measured money and employment benefits, though its effect on benefit differentials between curricula is uncertain.

5. Over the six-year period, vocational-technical graduates who have not attended college experience higher earnings and employment benefits than do academic graduates, even though employment for the former declines by more percentage points than it does for the latter.

6. Employment and earnings for the various vocational-technical courses strongly reflect the distribution of students by sex in each course.

APPENDIX TO CHAPTER VI: SOME OBSERVATIONS ON DATA AVAILABILITY

The discussions of Chapter V and Chapter VI point out serious problems with respect to the quality and availability of the data needed to perform valid economic analysis of investments in education. As shown previously, in some cases the most rudimentary data needed to make economic decisions on a relatively gross level simply do not exist. There are several reasons for this. First, the collection and codification of data in great detail are expensive. It is not reasonable to expect a school district to expend resources to collect data series for which it sees no effective use or which it does not understand how to use.

Second, the data needs of decision-makers at different levels in the educational system do not always coincide since the problems facing decision-makers at each level are not necessarily the same. Third, and most serious, the concept of rational economic analysis of the educational process and educational systems is relatively new. It has not always been apparent that financial and educational system data being collected ought to coincide with the needs of economic decision-making.

Handbook II. The cost data collected in this study are generally reported in a format similar to that recommended in Handbook II, Financial Accounting for Local and State School Systems. Since this is the case, some comments on this handbook are in order.[1]

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[1] Many of the comments here are based on Arthur Corazzini and A. Klevorick, Report of the Conference on Academic Research Interests in the Proposed Revision of Handbook II: Financial Accounting for Local and State School Systems, Boston, Mass., 1967, mimeographed.

First, even though an Executive Order has been issued which specifies that the administrative branches of the government should set up program-planning-budgeting systems (PPBS), this cannot be done until the objectives of the various administrative agencies are specified by these agencies. With respect to education, the objectives of education as envisioned by the society and verbalized by the Department of Health, Education, and Welfare must be clearly specified. One of these (non-mutually exclusive) objectives will be economic efficiency. With economic efficiency as an objective, economic cost data should conform to economic needs and definitions. In this regard, Handbook II makes several errors. First, it attempts to prorate joint costs among functions and activities. From an economic standpoint, this is erroneous. Recording of marginal costs by program, function or activity are all that is necessary for the decision-making process. Second, on a less serious level, the category Fixed Charges is not fixed charges at all, but simply wages, rents and other payments which in most cases are allocable to other categories in the Handbook. For instance, social security or retirement payments represent wage costs and should be so allocated. Third, capital expenditures should be isolated more carefully from plant operation and maintenance costs. This is a necessity because capital expenditures are lumpy and yield services over time.

In addition, educational accounting should be performed on a cost accounting basis. This should be conducted at the school level in each system. Only if theoretically sound cost accounting is instituted will the necessary data for complete marginal costing of educational programs and activities be possible. There is no reason why federal subsidies should not be paid to local school systems to perform this cost accounting if the federal government wishes to obtain the data necessary to facilitate PPBS. Standard programs, functions, and activities should be specified to which the cost accounting should be related.

It is not necessary to canvass the universe of school systems in the United States to obtain an accurate picture of costs. Annual sample national surveys of a stratified random sample of school districts should be conducted and kept consistent from year to year. The data which are now reported in the Statistics of School Systems and the Digest of Educational Statistics simply are not adequate for cost-benefit analysis and the method of collecting these data is too costly and time consuming. It would seem to be much more reasonable to establish a statistically representative national sample of school districts and to collect detailed cost data by program, curriculum, and course based upon the school as the unit of observation. Part of the cost of this data collection should be borne by each of the levels of government involved. The sample composition should be identified in advance so that appropriate cost accounting by program area can be accomplished. Of course, data collected in the other

Handbooks in this series must be geared to the accounting techniques specified by educational needs and economic theory.

As matters stand now, educational cost data are of limited use for economic analysis. Crude estimates of net present values and internal rates of return by year of school have been computed in this study, but this simply identifies the limits of analysis which can be performed under the present data system. Interesting questions which need solutions will continue to be unresolved as shown by the struggle encountered in this study to make a broad judgment between vocational-technical education and other types of education at the secondary level.

CHAPTER VII

STATISTICAL ANALYSIS OF COSTS

The conceptual issues and data required for economic analysis of education were discussed in earlier chapters. This chapter reports a statistical analysis of costs of senior high schools in City A and City C with a view to provide information on the efficiency of resource allocation in education.

A. Framework of Analysis

The costs which are analyzed here are the supply costs of education. The supply costs may be broadly classified into two groups: current costs which include expenditures for school operations on such items as teacher salaries, power, or heating; capital costs which include expenditures incurred on such items as buildings or equipment. However, because of the arbitrary nature of ascertaining capital costs for individual years, this study concentrates mainly on an analysis of current costs.[1]

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[1] Capital costs represent a very small proportion of total costs. In the estimation of annual capital costs the capital recovery factor was employed and an average building life of 60 years and a social opportunity cost rate of 10 percent was assumed. After adjusting original cost to reflect current replacement cost, clearly an overestimate, capital costs of buildings represent about 7.2 percent of total costs for comprehensive senior high schools ($797,910 current costs and $57,340 capital costs on the average over the 1956 through 1960 fiscal years). They represent about 8.4 percent of total costs for vocational-technical senior high schools ($668,810 in current (Continued)

Current costs of school operations are analyzed with two types of statistical functions: a total cost function and an average cost function. The total cost function permits inferences about marginal cost, the cost of instructing an additional student. The average current cost function permits inferences about the optimal scale of operation for a school.

In the formulation of the total and average current cost functions, the assumption is that the only factor affecting the current costs of school operations is the quantity of output, in this case, the number of students educated. With this assumption, the total and average costs are related to the total number of students enrolled. It is argued, however, that the actual number of students attending a school reveals more realistically the relation of current costs to the size of the student body. Average daily attendance (ADA), therefore, is introduced as the explanatory output variable for the cost functions.

In this study, we are interested in the comparative costs of comprehensive and vocational-technical senior high schools. Average daily attendance for the two types of schools is incorporated as a separate variable in the cost functions. This formulation makes it possible to measure and compare the marginal costs of these two types of schools and to test whether there are significant differences between them.

The statistical functions of the total and average current costs are:

$$(19) \quad TC = A_0 + A_1X_1 + A_2X_2 + A_3X_2^2 + A_4X_3 + A_5X_3^2 + U_1$$

$$(20) \quad AC = B_0 + B_1X_1 + B_2X_2 + B_3X_2^2 + B_4X_3 + B_5X_3^2 + U_2$$

The variables used are defined as follows:

TC = Total current expenditures in dollars;

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1. (Continued) costs and \$56,000 in capital costs on the average over the 1956-60 fiscal years). Equipment costs are even more negligible. Failure to include these capital costs, which, due to the estimation technique are level annual costs, has only a minimal downward bias on marginal cost estimations.

AC = Average current expenditures per student in ADA, in dollars;

X_1 = 1 for vocational-technical senior high schools;

= 0 otherwise, i.e., comprehensive senior high schools;

X_2 = Average daily attendance (ADA, comprehensive senior high schools);

X_3 = Average daily attendance (ADA, vocational-technical senior high schools);

X_4 = Average teacher salaries (total teacher salaries divided by the number of teaching teachers) in dollars;

X_5 = Student-teacher ratio: average daily attendance divided by the number of teachers for City A. Average class size for City C; and,

U_1, U_2 = A random disturbance.

X_1 is introduced to provide different intercepts for comprehensive and vocational-technical schools. Average daily attendance squared is introduced to account for the nonlinear nature of the cost functions. Equations (19) and (20) imply a state of homogeneity for the quality of education. This assumption, however, is not quite realistic since the quality of education does vary from one school to another. This difference in quality may be assumed to be associated with the costs of instruction. It is, therefore, necessary to modify equations (19) and (20) to allow for quality differentials in instruction. The concept of the quality of education, however, is an abstract one. It is difficult if not impossible to measure. It is argued, however, that class size and teacher salaries reflect, in part, the quality of education. The reasoning behind this argument is that a teacher can devote a relatively large amount of attention to each student in a school with relatively small size of classes. Furthermore, the importance of teacher quality to educational quality is beyond debate. It is assumed that the level of salaries reflects the quality of teachers. This argument is based on the fact that salary level depends on merit, experience and education received by teachers. Also, in a competitive labor market a teacher's salary may reflect his productivity.

By assuming that teacher salaries and class size or the student-teacher ratio are proxy variables for the quality of education, the total current cost function is now modified as:

$$(21)\quad TC = C_0 + C_1X_1 + C_2X_2 + C_3X_2^2 + C_4X_3 + C_5X_3^2 + C_6X_4 + C_7X_5 + U_3$$

B. Data

Cross-section data on current costs based on individual schools within the school system are obtained from published sources in two of the three cities included in this study. In City A, the sample observations include 19 schools for the fiscal years ending 1956 and 1957, 21 schools for fiscal years 1958 and 1959, and 19 schools for the fiscal year 1960. The sample includes two major types of senior high schools: comprehensive and vocational-technical. Of these, only three are vocational-technical in each cross-section.

In City C, the sample contains observations on 11 schools for the fiscal years ending 1956 and 1957. Fourteen and 16 schools respectively in 1958 and 1959, and 18 schools in 1960. Of these, three are vocational-technical senior high schools or vocational-academic senior high schools.

In City B, cross-section data on current costs are not available. Time series data of aggregate current costs published by City B are available but analyses on the basis of these data are not comparable with that for Cities A and C and are too fragmentary to allow meaningful cost analysis. Therefore, cost analysis for City B will not be performed.

C. Statistical Results

The cross-section data described in the previous section are used to estimate statistical cost functions for each of the fiscal years ending 1956 through 1960 for both Cities A and C. For each of the two cities, individual cross-section data are also combined to estimate pooled cost functions, giving the weighted average of the individual cross-section equations.

Tables 16 and 17 show the estimated total current cost equations based on equation (19). Estimates of the total cost function based on equation (21) are shown in Tables 18 and 19. The estimated average cost function based on equation (20) is presented in Tables 22 and 23.

In analyzing the statistical results presented here, it should be noted that the purpose is to illustrate the analytical procedures for resource allocation as well as to provide empirical evidence for statistical inference. In the course of estimating the cost functions,

TABLE 16

ANALYSIS OF TOTAL CURRENT COSTS, CITY A, FISCAL YEAR 1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-60	
Intercept	146,006 (133,757)	158,827 (172,903)	198,818 (148,644)	262,936 (149,714)	363,951* (139,100)	145,624* (61,678)	1957 = 30,018@ (30,740)
Vocational-Technical	-1,742,132 (2,263,561)	-1,897,142 (3,320,843)	-188,947 (216,514)	-243,321 (207,387)	-328,561 (194,328)	-266,472* (97,946)	1958 = 102,169** (30,154)
ADA (Comprehensive)	312.18 (171.24)	344.90 (220.01)	322.39 (180.14)	229.35 (166.82)	299.93 (145.81)	284.09** (68.45)	1959 = 95,264** (30,196)
ADA^2 (Comprehensive)	.0050 (.0481)	.01799 (.06103)	.0006 (.0489)	.0239 (.0418)	.0030 (.0350)	.0062 (.0180)	1960 = 234,486** (31,075)
ADA (Vocational-Technical)	2,365.24 (2,032.41)	2,691.51 (4,083.08)	661.58 (330.02)	680.10* (283.65)	743.90* (263.09)	686.88** (139.41)	
ADA^2 (Vocational-Technical)	-.5522 (.7443)	-.6674 (1.2244)	-.0741 (.1502)	-.0842 (.1223)	-.0784 (.1108)	-.0782 (.0577)	
$\bar{R}^2$	.8242	.7198	.8467	.8723	.9175	.8942	
SEE	96,598	124,552	108,762	103,710	84,789	94,641	
Number of Observations	19	19	21	21	19	99	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- @ Coefficients of dummy variables for the respective years.
- $\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
- SEE Standard error of the estimate.

The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

TABLE 17

ANALYSIS OF TOTAL CURRENT COSTS, CITY C, FISCAL YEAR 1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-60	
Intercept	185,861 (370,629)	-175,916 (145,273)	1,302,512** (269,298)	1,169,604** (228,764)	1,148,134** (286,725)	203,711* (87,301)	1957 = -19,484@ (35,485)
Vocational-Technical	47,978 (77,142)	53,044 (52,512)	-1,208,319** (307,525)	-695,812* (306,644)	1,167,590** (407,252)	17,753 (63,096)	1958 = 13,947 (35,180)
ADA (Comprehensive)	189.82 (337.68)	470.19** (127.41)	296.91* (125.42)	39.68 (162.12)	466.14 (231.65)	189.83* (76.60)	1959 = 59,431 (33,869)
ADA^2 (Comprehensive)	.0113 (.0610)	-.0342 (.0210)	-.00155 (.0224)	.0437 (.0284)	-.0279 (.0434)	.0161 (.0135)	1960 = 151,560** (33,011)
ADA (Vocational-Technical)	223.22 (485.95)	713.91** (184.61)	-811.45** (266.62)	-683.05** (219.10)	-663.57* (285.06)	211.50* (81.22)	
ADA^2 (Vocational-Technical)	.0514 (.1215)	-.0783 (.0431)	.2192** (.0492)	.1804** (.0367)	.1941** (.0482)	.0377* (.0149)	
$\bar{R}^2$	.9848	.9820	.9766	.9717	.9703	.9549	
SEE	58,926	40,971	57,585	54,097	67,779	82,676	
Number of Observations	11	11	14	16	18	70	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- @ Coefficients of dummy variables for the respective years.
- $\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
- SEE Standard error of the estimate.

The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

TABLE 18

ANALYSIS OF TOTAL CURRENT COSTS, CITY A, FISCAL YEAR
1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-60	
Intercept	-138,520 (161,089)	122,664 (261,373)	12,284 (296,235)	74,412 (149,823)	902,502* (357,004)	70,596 (98,267)	1957 = 4,187@ (21,578)
Vocational-Technical	-1,396,774 (1,113,194)	-889,524 (2,289,759)	-55,171 (202,550)	-149,667 (92,592)	181,224 (202,714)	-162,149* (70,869)	1958 = 57,866** (21,491)
ADA (Comprehensive)	454.61** (100.12)	526.67** (183.78)	547.18* (204.61)	562.52** (95.02)	891.07** (195.19)	529.52** (61.59)	1959 = 37,672 (21,853)
ADA^2 (Comprehensive)	-.0276 (.0251)	-.0387 (.0461)	-.0475 (.0502)	-.0396 (.0211)	-.0991* (.0379)	-.0374* (.0143)	1960 = 124,878** (24,734)
ADA (Vocational-Technical)	2,050.29 (1,285.88)	1,555.10 (2,799.15)	609.86 (301.36)	759.18** (121.66)	670.51** (193.50)	713.81** (95.52)	
ADA^2 (Vocational-Technical)	-.4523 (.3635)	-.3149 (.8395)	-.0398 (.1360)	-.0804 (.0520)	-.0335 (.0816)	-.0679 (.0403)	
Student-Teacher Ratio	-35,272** (9,179)	-47,201** (16,369)	-27,275 (16,661)	-44,995** (8,449)	-80,458** (23,204)	-39,288** (5,790)	
Average Teacher Salary	141.03** (24.77)	115.52** (35.41)	80.06 (40.88)	110.32** (18.53)	28.72 (35.24)	96.45** (12.99)	
$\bar{R}^2$	.9586	.8695	.8755	.9768	.9559	.9494	
SEE	46,540	84,346	97,377	43,983	61,503	65,606	
Number of Observations	19	19	21	21	19	99	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
@ Coefficients of the dummy variables for the respective years.
$\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
SEE Standard error of the estimate.
The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

TABLE 19

ANALYSIS OF TOTAL CURRENT COSTS, CITY C, FISCAL YEAR 1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-1960	
Intercept	2,488,950** (673,381)	-657,233 (1,251,079)	-571,373 (334,802)	245,160 (231,992)	104,780 (335,415)	-168,357 (174,023)	1957 = 8,466@ (24,059)
Vocational-Technical	-15,966 (25,404)	-51,100 (282,639)	-564,838 (337,383)	-214,368 (319,137)	-1,381,668* (494,498)	-64,594 (43,125)	1958 = 32,573 (24,099)
ADA (Comprehensive)	-8.25 (152.27)	512.61* (199.14)	328.40** (55.65)	241.83* (110.17)	623.95** (161.24)	478.17** (60.58)	1959 = 57,968* (22,591)
ADA^2 (Comprehensive)	.0518 (.0278)	-.0415 (.0331)	-.0042 (.0102)	.0096 (.0189)	-.0575 (.0301)	-.0327** (.0106)	1960 = 110,129** (22,454)
ADA (Vocational-Technical)	-119.05 (168.86)	369.23 (912.17)	-239.09 (309.46)	-2.15 (221.59)	-633.76 (417.18)	378.26** (57.38)	
ADA^2 (Vocational-Technical)	.1275** (.0381)	.0228 (.2648)	.1311* (.0553)	.0714 (.0369)	.1870* (.0668)	.0174 (.0101)	
Average Class Size	-67,864** (14,229)	968 (12,575)	13,522 (11,359)	-12,778 (8,579)	11,708 (14,840)	16,054** (4,313)	
Average Teacher Salary	7.43 (203.84)	742.48 (1,916.91)	1,038.02** (171.25)	777.32** (151.11)	975.87** (276.03)	815.11** (108.52)	
$\bar{R}^2$	.9965	.9655	.9954	.9946	.9864	.9801	
SEE	16,784	49,244	24,808	26,878	45,607	54,966	
Number of Observations	11	11	14	16	18	70	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- @ Coefficients of the dummy variables for the respective years.
- $\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
- SEE Standard error of the estimate.

The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

a number of limitations in the data used became apparent. These limitations include: 1) Total current costs include expenditures on additions, renovations and repairs on buildings which vary from one year to another. This variation gives rise to differences in the estimated relationships between cross-sections; 2) The size of sample used in this study is small, particularly in the number of vocational-technical schools. The observations thus do not include schools of all possible sizes. Under such circumstances, any addition or deletion of one school could result in a major shift in the slope of the statistical cost functions.

Within the context of the limitations cited above, the statistical results may be summarized as follows: 1) The estimated relationships indicate that a very significant proportion of the variance in the total and average current costs is explained by average daily attendance. 2) There appears to be some difference in the estimated relations between cross-sections. However, the difference appears to be more pronounced in the relations estimated for City C than in those for City A. In other words, the total and average cost functions estimated for City A are relatively stable over the period 1956 through 1960 as compared with the corresponding equations estimated for City C. Because of the difference in the estimated relations for individual years, the weighted average obtained by the pooled equation provides more satisfactory empirical evidence for statistical inference. 3) There is a significant negative relation between total (and average) current cost and average class size. Average teacher salary is positively correlated with the total and average current costs as one would expect. If class size and teacher salaries properly reflect the quality of education as assumed, the result implies that quality can be improved at additional cost. It should be noted, nevertheless, that average class size and average teacher salary do not directly measure but only approximate the quality of education. This is so because total cost increases in direct proportion to an increase in average teacher salary and decreases in direct inverse proportion to an increase in class size. But the quality of education cannot be improved monotonically with the increase in total costs, that is, quality cannot be increased in direct proportion to the increase in total expenditure.

As indicated earlier, we wish to obtain (1) the marginal (extra) cost of instructing an additional student, and (2) the optimal scale of operation of a senior high school. To obtain marginal cost, we make use of the total cost function. However, the total costs are assumed to be a nonlinear function of average daily attendance (ADA). Marginal cost is, therefore, different for different levels of ADA.[2]

The level of ADA which we use to calculate marginal cost is average ADA. The calculated values of marginal cost are shown for City A and City C in Tables 20 and 21. These marginal costs are calculated on the basis of the relations shown in Tables 16 and 17. In City A, for the years considered, the estimated marginal costs for comprehensive senior high schools at average ADA range from $313 to $414 in contrast to the range of $408 to $539 for vocational-technical senior high schools. For specific comparison, we refer to the results obtained from the pooled equation. The marginal cost for comprehensive senior high schools at average ADA is $304 in comparison to $464 for vocational-technical senior high schools. The difference amounts to $160.

In City C, the marginal costs for comprehensive senior high schools at average ADA range from $240 to $354 as compared to the range of $194 to $457 for vocational-technical senior high schools. The marginal costs evaluated from the pooled equation for comprehensive and vocational-technical senior high schools are respectively $270 and $386--a difference of $116.

A comparison of marginal cost tables for City A and City C also shows that marginal cost in City A is higher than that of the corresponding types of school in City C. On the basis of the pooled equations, the marginal costs evaluated for average ADA for comprehensive senior high schools is $304 in City A and $270 in City C. For vocational-technical senior high schools, the marginal cost is $464 in City A as compared with $386 in City C.

We also experimentally impute annual capital costs for City A by employing the capital recovery factor. In this imputation, an average building life of 60 years and a social opportunity cost rate of 10 percent were assumed. The resulting costs are added to total current cost. The total (capital and current) costs are related to average daily attendance. The equation estimated with the 1956-60 pooled data is:

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[2] We also estimate a linear total cost function. This procedure is in essence a linear approximation to a nonlinear relationship. The resulting linear approximation gives constant marginal costs and these costs are also presented in Tables 20 and 21. As these tables show, the marginal costs obtained by linear approximation are to a large extent compatible with marginal costs evaluated at average ADA for the nonlinear total cost functions.

TABLE 20

MARGINAL COSTS BASED ON THE TOTAL CURRENT COST FUNCTION, CITY A, FOR THE FISCAL YEARS 1955-1956 THROUGH 1959-1960, IN DOLLARS

Year	Comprehensive			Vocational-Technical		
	Average ADA	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation	Average ADA	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
1956	1,834	331	295	1,772	408	416
1957	1,827	411	281	1,667	466	470
1958	1,820	325	325	1,254	476	504
1959	1,993	325	323	1,279	465	492
1960	2,126	313	312	1,303	540	563
1956-60	1,917	308	307	1,426	464	504
1955-60@	1,917	312	321	1,426	485	525

Notes: @ Calculated from equation (22)

TABLE 21

MARGINAL COSTS BASED ON THE TOTAL CURRENT COST FUNCTION, CITY C, FOR THE FISCAL YEARS 1955-1956 THROUGH 1959-1960, IN DOLLARS

Year	Comprehensive			Vocational-Technical		
	Average ADA	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation	Average ADA	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
1956	2,232	240	258	2,031	432	407
1957	2,714	285	262	2,229	365	380
1958	2,513	289	288	2,294	194	371
1959	2,511	259	288	2,474	210	390
1960	2,458	329	318	2,428	279	480
1956-60	2,505	270	285	2,316	386	409

$$(22)\quad TC' = \underset{(55{,}262)}{125{,}315} - \underset{(66{,}807)}{147{,}652X_1} + \underset{(60.00)}{368.02X_2} - \underset{(.0156)}{.0125X_2^2} + \underset{(106.61)}{640.16X_3}$$

$$- \underset{(.0494)}{.0542X_3^2} + \underset{(29{,}088)}{45{,}969\ (1957)} + \underset{(28{,}789)}{63{,}332\ (1958)} + \underset{(29{,}157)}{77{,}840\ (1959)}$$

$$+ \underset{(30{,}051)}{164{,}813\ (1960)}$$

$$\bar{R}^2 = .9178 \qquad SEE = 93{,}029$$

The marginal costs, shown in the last row of Table 20, are slightly higher than the marginal current costs described earlier.

Aside from our interest in the extra costs of instructing an additional student, we are also interested in the question of the economies of scale in senior high school operations. An examination of Tables 22 and 23 indicates that the average cost curve decreases, reaches a minimum, and then increases with the increase in ADA. For the purpose of our analysis we follow economic theory and define optimal scale as the level of output (ADA) at which the average cost is at a minimum.

Differentiating the average cost function with respect to ADA, setting its partial derivative equal to zero, and solving for the level of output which minimizes average cost gives the desired answer. The level of ADA at which average cost is minimum on the basis of the pooled equations is as follows:

	Comprehensive	Vocational-technical
City A	2,957	2,295
City A[3]	3,350	1,958
City C	3,191	3,339

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[3] This value is calculated from the average total (capital and current) cost function. The estimated equation is as follows:

(Continued on page 128)

TABLE 22

ANALYSIS OF AVERAGE CURRENT COSTS, CITY A, FISCAL YEARS
1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-60	
Intercept	607.49** (81.28)	633.91** (92.28)	757.49** (111.85)	805.41** (124.59)	1,142.89** (122.45)	695.37** (47.34)	1957 = 28.22@ (23.59)
Vocational-Technical	-1,034.83 (1,375.56)	-1,170.58 (1,772.52)	23.53 (162.70)	10.87 (172.59)	-149.09 (171.07)	66.73 (75.17)	1958 = 57.26 (23.14)
ADA (Comprehensive)	-.1706 (.1041)	-.1522 (.1174)	-.2675 (.1354)	-.3285* (.1388)	-.5245** (.1284)	-.2543** (.0525)	1959 = 56.56* (23.17)
ADA^2 (Comprehensive)	.0000278 (.0000292)	.0000191 (.0000325)	.0000490 (.0000368)	.0000633 (.0000348)	.0000952** (.0000308)	.0000430** (.0000138)	1960 = 145.56** (23.85)
ADA (Vocational-Technical)	1.0467 (1.5997)	1.2999 (2.1794)	-.1607 (.2480)	-.2333 (.2361)	-.3573 (.2316)	-.2703* (.1070)	
ADA^2 (Vocational-Technical)	-.0003001 (.0004523)	-.0003938 (.0006536)	.0000270 (.0001128)	.0000426 (.0001017)	-.0000809 (.0000975)	.0000589 (.0000443)	
$\bar{R}^2$	.3697	.4017	.4488	.5196	.7664	.6735	
SEE	58.70	66.48	81.85	86.31	74.64	72.63	
Number of Observations	19	19	21	21	19	99	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- @ Coefficients of the dummy variables for the respective years.
- $\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
- SEE Standard error of the estimate.

The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

TABLE 23

ANALYSIS OF AVERAGE CURRENT COSTS, CITY C, FISCAL YEARS
1955-1956 THROUGH 1959-1960, IN DOLLARS

Independent Variables	1956	1957	1958	1959	1960	1956-60	
Intercept	492.60* (219.01)	328.99** (63.09)	1,556.44 (165.29)	1,386.71** (144.97)	1,456.35** (144.86)	599.20** (58.10)	1957 = -7.99$^@$ (23.86)
Vocational-Technical	32.27 (45.58)	51.31* (22.81)	-1,151.58 (188.75)	-690.84** (194.33)	-956.88** (205.76)	20.73 (41.99)	1958 = 9.07 (23.41)
ADA (Comprehensive)	-.1393 (.1995)	-.0227 (.0553)	-.0377* (.0770)	-.2393* (.1027)	-.0644 (.1170)	-.2138** (.0510)	1959 = 33.78 (22.54)
ADA^2 (Comprehensive)	.0000207 (.0000361)	.0000007 (.0000091)	.0000037 (.0000138)	.0000372 (.0000180)	.0000073 (.0000219)	.0000335** (.0000090)	1960 = 74.50** (21.97)
ADA (Vocational-Technical)	-.0459 (.2872)	.1771 (.0802)	-1.0391** (.1636)	-.8766** (.1388)	-.9304** (.1440)	-.1349* (.0541)	
ADA^2 (Vocational-Technical)	.0000094 (.0000718)	-.0000465 (.0000187)	.0001836** (.0000302)	.0001424** (.0000233)	.0001543** (.0000244)	.0000202 (.0000099)	
$\bar{R}^2$	.6132	.8420	.8390	.7963	.8013	.5340	
SEE	34.82	17.79	35.34	34.28	34.24	55.02	
Number of Observations	11	11	14	16	18	70	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- @ Coefficients of the dummy variables for the respective years.
- $\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
- SEE Standard error of the estimate.

The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

If the statistical results derived in this study are reliable, the optimal scale of size for senior high schools is about 3,000 for comprehensive schools. However, when capital costs are taken into account the optimal size of the comprehensive senior high school is about 10 percent higher for City A. Because of the small number of observations in the case of vocational-technical schools, however, caution should be exercised in any attempt to draw inferences about the economics of scale for the operations of this type of school. The optimal scale which we infer here is also limited by the fact that we are concerned mainly with current costs. A component in the economies of use of resources exist in the use of fixed equipment. This component is included only imperfectly in our analysis here.

D. Costs by Course of Instruction

In addition to our study of the current costs of school operations, we also explore the availability of cost data by course of instruction. However, we are only able to obtain teacher salaries by course of instruction in time series form for City A. The total teacher salaries are related to average daily attendance in each program. The results are shown in Table 24.

In eight of the nine groups of courses, total teacher salaries are significantly related to average daily attendance. As expected, the slope of the relation of total teacher salaries to average daily attendance differs from one program to another. For the purpose of illustration, marginal costs for each type of program are calculated at average ADA as follows:

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3. (Continued)

$$\begin{array}{llllll} AC' = 751.29 - 5.79X_1 & - .2679X_2 & + .00004X_2^2 & - .2349X_3 & + .00006X_3^2 \\ \quad (46.36)(56.04) & (.0503) & (.00001) & (.0894) & (.00004) \end{array}$$

$$\begin{array}{llll} + 27.82\ (1957) & + 45.41\ (1958) & + 50.13\ (1959) & + 114.30\ (1960) \\ (24.40) & (24.15) & (24.46) & (25.21) \end{array}$$

$\bar{R}^2 = .6705 \qquad SEE = 78.04$

TABLE 24

ANALYSIS OF TOTAL TEACHER COSTS IN VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS OF CITY A BY COURSE OF INSTRUCTION, FOR THE POOLED FISCAL YEARS 1960-61 THROUGH 1966-67, IN DOLLARS[@]

Independent Variables	Course							
	Food	Building Trades	Mechanical & Repair	Wood Working	Cloth Fabric	Electrical & Electronics	Agriculture & Horticulture	Personal Services
Intercept	-57,764** (16,919)	-11,895 (60,416)	-22,238** (6,002)	-6,334* (3,102)	-6,214 (4,627)	-87 (3,780)	-25,915* (9,323)	-17,501 (10,184)
ADA	1,086.72** (295.64)	554.44 (1,861.45)	259.82** (75.47)	277.62** (87.49)	117.67 (59.56)	89.60* (34.10)	280.81* (123.57)	113.29 (117.36)
ADA^2	-3.7782** (1.2986)	-4.3968 (13.7317)	-.1666 (.1867)	-1.1638 (.6118)	.1128* (.0487)	.3723** (.1118)	-.0572 (.3396)	.6049 (.4675)
Time Trend	4,325** (981)	2,692* (1,254)	4,094** (1,036)	1,432** (400)	1,937* (738)	438 (609)	4,676** (1,216)	3,008** (1,021)
$\bar{R}^2$	.5997	.0953	.8151	.4865	.7136	.9943	.7851	.8099
SEE	6,437	9,360	13,049	4,847	10,039	1,644	12,764	6,291
Number of Observations	13	18	45	36	47	11	27	17

Notes: @ Data for fiscal year 1965-66 were not available.
* Significant at the .05 level.
** Significant at the .01 level.
$\bar{R}^2$ Coefficient of determination adjusted for degrees of freedom.
SEE Standard error of the estimate.
The data displayed are the partial regression coefficients and, in parentheses, their respective standard errors.

TABLE 25

MARGINAL TEACHER SALARY COSTS BY COURSE FOR VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS IN CITY A, BY AVERAGE DAILY ATTENDANCE FOR THE POOLED FISCAL YEARS 1961-1967, EXCLUSIVE OF FISCAL YEAR 1966, IN DOLLARS

Course	Average ADA	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
Food Service	89	415	247
Building Trade	68	*	*
Mechanics	170	203	194
Woodworking	74	106	116
Clothing and Fabrics	115	144	161
Electric and Electronics	88	155	202
Agriculture and Horticulture	117	267	260
Personal Service	111	248	260

Notes: * = not evaluated

The marginal costs range from a low of $106 for woodworking to a high of $415 for the food service course. No marginal costs for building trade group is evaluated because the total teacher salaries are not significantly related to average daily attendance.

E. Summary

This investigation of current costs is concerned with marginal costs and optimal scale of school size with a view to providing empirical evidence related to resource allocation. The analytic approach of this study, therefore, is distinctly different from that of Corazzini's and Taussig's studies[4] where the principal topic of concern is the average cost of education.

In the course of this study, serious limitations in our cost data were evident. But the analytic procedures are useful for further studies of the cost of school operations when we are concerned with the efficiency of resource allocation in education.

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[4] See Chapter III.

CHAPTER VIII

STATISTICAL ANALYSIS OF BENEFITS

A. Introduction

The statistical analysis of costs of vocational-technical and comprehensive high school operations was discussed in Chapter VII. This chapter reports a statistical analysis of benefits among senior high school graduates so that a comparison of benefits and costs among different curricula can be studied in Chapter IX.

The measurement of economic benefits for senior high school graduates who do not attend college can be considered in terms of their labor market performance after their graduation. Of course, this measurement does not include all monetary benefits or other non-monetary benefits. Labor market performance is only an index of benefit for these high school graduates. The differences in their labor market performances are not due solely to their different training. Factors such as sex, IQ, race, and family background are also very important. Therefore, in order to compute or to attribute the net effect of graduates' curricula on their labor market performance, it is necessary to control for their socio-demographic characteristics. Thus, multiple regression analysis is employed in this study.

The basic data on benefits for this study were obtained from the responses to 1,255 mail questionnaires of senior high school graduates from Cities A, B, and C (648 for A; 313 for B; and 294 for C) during 1966 and 1967. These questionnaires were sent to graduates for the classes of 1959 and 1960 (January and June). The overall rate of response was approximately one-third of the selected sample. The possible bias which the non-respondent group would impart to the study findings is not known with certainty. The comparison of respondents and non-respondents sample characteristics and the test between these two groups are represented in Appendix IV.

To derive an accurate comparison of the labor market performance among graduates, it is necessary to consider only those who did not attend college but who started into the labor market directly after graduation. In the study, this kind of graduate is referred to as a non-college graduate. The 1,255 observations in the regression analysis are all non-college graduates. The characteristics of the respondent sample were discussed in Chapter VI.

There are five types of high school curricula among the graduates: 1) the academic curriculum for those who were college orientated; 2) the vocational-academic curriculum for those who had a dual qualification both as academic and vocational-technical graduates; 3) the general curriculum, whose curriculum was below the level of college preparatory and whose basic characteristic appears to be a lack of specific career orientation; 4) the vocational-comprehensive curriculum, which included those who took vocationally oriented courses but whose preparation was less concentrated than vocational-technical; and 5) the vocational-technical curriculum for those who concentrated their efforts in a coherent area of vocational or technical study.

Although the objective functions of academic high school and vocational-technical high school are different, it does not mean that all academic high school graduates intend to attend college. A large portion of students who choose to take the academic curriculum may not be certain about their future plans. In other words, the academic high school student carries with him a relatively larger option value with respect to his prospects of future college attendance. However, this option value will diminish or disappear over time once the academic high school graduate enters the labor market.

B. Description of the Variables

The Dependent Variables. The purpose of the study is to compare the performance among senior high school graduates in the labor market over the six-year period following their graduation. The measurements of performance are: 1) average monthly earnings before and after taxes for the six-year period following graduation; and 2) the percent of time employed in the six-year period. In order to measure the changes in performance, the statistical model includes: 1) average monthly earnings before and after taxes in the first year after graduation; 2) average monthly earnings before and after taxes in the sixth year after graduation; 3) the percent of time employed in the first year following graduation; and 4) the percent of time employed in the sixth year following graduation.

Earnings before taxes are considered as social economic benefits, since these earnings represent an increase in national income. The increase in national income implies an increase in social welfare. Earnings after taxes are considered as private economic benefits, since these earnings represent personal disposable income. Most of the discussion in this chapter will be devoted to social benefits. However, after-tax earnings will be discussed in the latter part of the chapter.

The use of the percent of time employed as a dependent variable gives an explicit measurement of employment as a policy goal of education, while the use of earnings as a dependent variable gives an explicit measurement of the major monetary benefits of education.

There are certain qualifications to the dependent variables of employment and earnings which should be mentioned. First, neither employment nor earnings variables measure the exact amount of total social benefits. For instance, the percent of time employed does not indicate the wage rate that a graduate obtains. Earnings reflect an important part of monetary benefits, but earnings do not necessarily indicate the increased productivity of workers associated with the graduates in the sample. Therefore, one should be aware that both employment and earnings are only indices of social benefits. Second, in the market economy, both percent of time employed and earnings are determined by the level of supply and demand for different labor skills in the labor market. The supply and demand structure of the labor market varies from one place to another and from time to time. Therefore, the differences in percent of time employed and in earnings among senior high school graduates may not be solely due to the type of curriculum of the graduates.

There is another dependent variable, the number of weeks needed to find the first job after graduation, which is complementary to the employment variable. Further, this variable will be considered as a part of job search cost among five types of curricula.

The Independent Variables. There are seven independent variables which are conceptually relevant in the model. These variables are: city of graduation; type of curriculum; sex; IQ; race; marital status; and father's education. Among these seven independent variables, each set is expressed in terms of dummy variables, except for IQ and father's education.

City of Graduation. This variable set has three elements, City A, City B, and City C. The city variable represents the differences in educational institutions, the different industrial structures, labor market structures, price levels, and other economic and demographic factors of the given cities. Such factors will have an impact on employment and earnings of senior high school graduates. City A is the omitted regressor of the variable and, thus, the effect of being a high school graduate in City A enters into the intercept term of the equation. The differences of the effect between City A and City B and between City A and City C are represented by the partial regression coefficients of the City B and City C regressors.

Curriculum. The previous discussion has indicated that there are five curriculum regressors for the curriculum variable. The dummy regressor for the academic curriculum is omitted and the effect of being a senior high school academic graduate enters into the intercept term of the equation. Since the major purpose of this study is to compare the benefits and costs of providing vocational-technical and academic education, these two curriculum variables are crucial to the analysis which follows.

Socio-Demographic Variables. This general category includes sex, IQ, race, marital status, and father's education. The differences in labor market performance of high school graduates cannot be explained solely by the kind of curriculum in which they are enrolled. The differences in labor market performance are also affected by a graduate's family background, personality, motivation, and intelligence. Father's education is used to represent a graduate's family and social background. Sex and race represent not only a graduate's personality but also control for labor market biases and differential productivity associated with sex and race; and IQ represents a graduate's intelligence. Marital status helps control for life cycle effects which influence labor market behavior. To a certain extent, these socio-demographic variables can control for the effect of personality differences. In other words, only if these socio-demographic variables are included in the equation can the coefficients of the curriculum variable regressors represent the net effect due to different types of curricula. Of course, this net effect is net only in terms of the other variables included in the equations.

These high school graduates have four different times of graduation, January and June of 1959 and January and June of 1960. Two dummy variables to control for year and month of graduation were introduced in the analysis but both were not statistically significant. Therefore, these dummy variables were not included in the final analysis. There are other relevant independent variables which may affect a graduate's labor market performance, such as the training relatedness to the job, military training experience, and on-the-job training. These variables will be examined toward the latter part of this chapter.

It should be noted that all these independent variables are not "independent" of each other. For instance, IQ may be positively correlated with father's education; type of curriculum may be correlated with father's education; and race and sex may be correlated with type of curriculum. The presence of interdependence among these independent variables may obscure the true nature of the empirical relationships which exist for each of the variables in the data.

This chapter will first present the regression equations including all 1,255 observations. Then, to overcome the interaction effects among these independent variables, we will separate male and female graduates and white and nonwhite graduates, and estimate separate regression equations for each of these.

C. Non-College High School Graduates

The regression analysis compares the labor market performance of all non-college graduates in terms of before-tax earnings, after-tax earnings, and employment.

Before-Tax Earnings. Table 26 presents the regression analysis of average before-tax monthly earnings of non-college senior high school graduates in the six-year period after graduation. Among these three regression equations, the adjusted coefficients of determination ($\bar{R}^2$) vary from 0.16 and 0.40 and all are statistically significant at the 0.01 level.

There are several interesting phenomena to be observed from the results in Table 26.

1) During the first year after graduation, the non-college vocational-technical graduates earned, on net, (that is, holding the effects of differences in geographic factors and the socio-demographic factors such as IQ, sex, race, etc., constant) $62 more per month (or $744 more in the first year) than the non-college academic graduates. Similarly, general curriculum graduates earned $30 more per month (or $360 more in the first year); vocational-comprehensive graduates earned $57 more per month (or $684 more in the first year); and vocational-academic graduates earned $52 more per month (or $624 more in the first year) than academic graduates.

The set of dummy regressors for the different curricula in the equation of first-year earnings is statistically significant at the .01 level. The differences between vocational-technical and academic and vocational-comprehensive and academic are statistically significant at the .01 level while the difference between general and academic and vocational-academic and academic are significant at the .05 level. Therefore, it is clear that academic graduates have earned less than vocational-technical graduates and graduates in other curricula during the first year after graduation. Furthermore, vocational-technical graduates have the highest earnings among all curricula during the first year after graduation.

2) During the sixth year after graduation, the set of dummy regressors for the curriculum variable is also statistically significant at the .01 level. However, only the difference between vocational-technical and academic graduates is statistically significant among the curriculum regressors. The earnings of

TABLE 26

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	54*	(22)	52*	(22)	50	(31)
Vocational-Comprehensive	36**	(12)	57**	(12)	24	(17)
General	18	(16)	30*	(15)	15	(22)
Vocational-Technical	48**	(11)	62**	(11)	54**	(15)
Labor Market						
City A@						
City B	-2	(10)	-0.10	(9)	-1	(14)
City C	9	(10)	-28**	(10)	46**	(14)
Male	200**	(9)	81**	(9)	328**	(12)
IQ	1.48**	(0.35)	1.10**	(0.34)	1.80**	(0.48)
White	61**	(12)	105**	(12)	-1	(17)
Marital Status						
Married@						
Single	50*	(9)	-8	(9)	122**	(13)
Separated, Widowed Divorced	-4*	(43)	-50	(42)	28	(60)
Father's Education	0.05	(1.35)	-0.41	(1.29)	0.01	(1.85)
Number of Observations	1,255		1,255		1,255	
Coefficient of Determination#	0.31		0.16		0.39	
Intercept	-5	(41)	-3	(39)	-42	(56)
Standard Error of Estimate	136		131		188	
Mean of Dependent Variable	300	(164)	258	(142)	299	(241)
F-Ratio:						
All Variables	48.23**		19.71**		68.70**	
Curriculum	5.40**		9.69**		3.83**	
Labor Market	0.56		4.50**		6.15**	
Marital Status	14.05**		1.10		43.96**	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

vocational-technical graduates are still the highest among all other curricula. The vocational-technical graduates earned $54 more per month (or $648 more in the sixth year) than academic graduates.

There are two important differences between the statistical results of the first year and the sixth year. First, the magnitude of the absolute differences of earnings among different kinds of curricula in the sixth year is, on the whole, much smaller than the absolute differences in the first year. Second, there is no statistical significance for the differences of earnings of the curricula during the sixth year, except for vocational-technical graduates.

One possible explanation is that in the early stages following graduation, the earnings of graduates are heavily influenced by the kind of training the graduates had in school. However, over the long-run, a graduate's performance in the labor market is highly related to his labor market experiences such as on-the-job training, his personality, intelligence, and motivation. The kind of curriculum in which a student was originally enrolled may become less and less important over time. The statistical results of the socio-demographic variables, which will be discussed later, tend to support this viewpoint.

3) The equation of average monthly earnings summarizes the overall performance during the entire six-year period after graduation. The results indicate that the vocational-technical graduates have earned $48 per month more (or $3,456 more in six years) than the non-college academic graduates, given that the two sets of graduates have the same socio-demographic backgrounds. This difference between the vocational-technical and the academic curriculum is statistically significant at the .01 level. The graduates of the vocational-comprehensive and vocational-academic curriculum also earned more than the academic graduates during the six-year period.

4) It is worthwhile to make a brief comparison between the results of this study and the results obtained by Arthur Corazzini[1] and Michael Taussig.[2] Corazzini estimated the difference in earnings between vocational and regular high school graduates based on the difference in the average starting wage for machine operators in Worcester, Massachusetts. He estimated the difference of earnings

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[1] Arthur Corazzini, op. cit., pp. 53-61.

[2] Michael Taussig, op. cit., pp. 35-46.

to range from $80 to $560 per year. Taussig estimated that the wage differentials of males employed in training related occupations in New York City increased by $0.12 per hour. This difference would result in a differential of $240 per year (assuming a 2000 hour work year).

The results of the present study indicate that vocational-technical graduates gained an average of $576 per year over the six-year period after graduation. The difference in the results between this study and the studies of Corazzini and Taussig reflect three different methodological techniques. First, both Corazzini and Taussig have not properly controlled for the socio-demographic factors which significantly affect the earnings of graduates. Therefore, their estimated earnings are gross in nature rather than net. Second, both Corazzini and Taussig used wage rates instead of earnings to calculate the benefits of graduates. The wage rate does not include the employment factor and yields a different measure of benefit. Third, each study has a different sample obtained from a different city and a different time.

5) It is useful to illustrate the estimated earnings of five types of graduates, based on the estimated results in Table 26. Assume that these five types of graduates were graduated in June 1960 in City A and are males, IQ = 104, white, married, and whose fathers have 10 years of education. These assumptions would yield the figures as shown in Table 27.

6) An examination of the effects of socio-demographic variables reveals that male graduates earned more than female graduates. During the first year, male graduates earned $972 more than the female graduates and they earned $3,939 more than the females during the sixth year. The male variable is significant at the .01 level in both periods. The explanation for the differences in earnings between male and female graduates lies in the fact that females generally marry soon after graduation and tend to leave the labor market. A separate examination of male and female graduates is necessary. This analysis will be pursued later in the chapter.

7) IQ is positively related with earnings. This variable is statistically significant at the .01 level in each of the equations in Table 26.

8) Race should be a significant factor in explaining the differences in earnings among the graduates. During the first year after graduation, white graduates gained $105 more in average monthly earnings than nonwhites. However, during the sixth year period, white graduates earned less than nonwhites. The difference is small

TABLE 27

ESTIMATED EARNINGS BY CURRICULUM OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES IN SIX-YEAR PERIOD AFTER GRADUATION, ASSUMING JUNE GRADUATION, 1960, IN CITY A FOR MARRIED WHITE MALES OF IQ = 104, WITH FATHERS HAVING TEN YEARS OF EDUCATION

Curriculum	Average Before-Tax Monthly Earnings		
	Average in Six Years	First Year After Graduation	Six Years After Graduation
Academic	$415	$292	$441[a]
Vocational-Academic	$469	$344	$486
Vocational-Comprehensive	$451	$349	$463
General	$433	$324	$454
Vocational-Technical	$463	$354	$491

[a] The change in price level is reflected in these figures. The figures have been deflated by 10 percent from their money values, 1960 as the base year.

Source: Based on estimated statistical equations in Table 26.

and not statistically significant. The possible explanation for nonwhite graduates earning more than whites during the sixth year period lies in the sex factor. In an examination of regression equations for males and females separately, we will find that white male graduates earned more than nonwhite males, but white female graduates earned less than nonwhite females. Furthermore, toward the sixth year period, most of the nonwhite females are still participating in the labor force while white females mostly [illegible]t. Since two-thirds of the sample is female, this factor explains the empirical earnings results of total white and nonwhite graduates during the sixth year period.

9) During the first year after graduation, there is no significant difference in earnings in terms of the marital status of graduates. However, it is interesting to note that during the sixth year period, single and separated, widowed or divorced persons earned more than the married graduates. Furthermore, the differences are statistically significant. This result is contradictory to what common sense would predict. This result again is explained by the sex factor since unmarried females participated in the labor force during the sixth year period while married females most likely stayed at home. Since two-thirds of the sample is female, the earnings of marital status are dominated by interactions with the female observations.

10) Father's education is found to be not statistically significant in explaining differences in earnings. Perhaps the variation in father's education is small among the non-college graduates, though about 70 percent of respondents had fathers whose education ranged between 6 to 12 years.

11) Finally, the variable of city of graduation, the labor market variable, in the equations should be considered. There are differences among City A, City B, and City C for the first year and the sixth year. However, there is no significant difference in the six-year average earnings equation. Tables I, II, and III of Appendix V present the regression results for the graduates of each city. The discussions of these tables will be omitted since the signs and magnitudes of each coefficient are comparable and consistent with the coefficients shown in Table 26.

After-Tax Earnings. Earnings after taxes are considered as private earnings. The differences between before- and after-tax earnings are the amount of federal income and social security taxes the graduates paid. The amount of taxes graduates paid cannot be explained by factors of curriculum, sex, IQ, or race. The amount of taxes paid mainly depends on a graduate's family composition, number of dependents, and the occupation a graduate chooses. This study does not incorporate such information to analyze the differences in tax payment among graduates. Table 28 presents the earnings after tax among five types of graduates. The differences in after-tax earnings among the five types of graduates are very similar. The differences in before- and after-tax average monthly earnings vary from $2 to $10. The patterns of statistical significance among equations of the two kinds of earnings are almost the same. Therefore, no further detailed discussions of the results of these explanatory variables in these equations will be made.

Employment. The employment experience for the five types of graduates is very much consistent with the results of the earnings equations. Table 29 presents the statistical results of employment performance of non-college high school graduates. Among those regression equations, the adjusted coefficients of determination ($\bar{R}^2$) vary from 0.12 to 0.28 and all are statistically significant at the .01 level.

The results can be summarized as follows:

1) During the first year after graduation, the vocational-technical graduates were employed, on net, 14 percentage points (or about 1.8 months) more than the academic graduates; vocational-comprehensive graduates were employed 13 percentage points (or 1.7 months) more; general graduates were employed 7 percentage points (or 3.6 weeks) more; and vocational-academic graduates were employed 11 percentage points (or 1.5 months) more than academic graduates. The differences are statistically significant at the .01 level.

2) There is supplementary information on the length of time it took the graduates to find their first job during the first year after graduation. This variable is considered to be a function of city, curriculum, sex, IQ, race, marital status, and father's education. The results support the findings on employment during the first year after graduation. As shown in Table 30, given the same socio-demographic conditions, in general, vocational-technical graduates took 11 weeks less than academic graduates to find their first job after graduation. Vocational-comprehensive and vocational-academic graduates took 10 weeks less and general curriculum graduates took 5 weeks less than academic graduates. Compared with first year employment equations, it is clear that the time unemployed is identical to the time of looking for the first job. This amount of time can be considered as a part of the cost for job search associated with each type of curriculum.

TABLE 28

AVERAGE AFTER TAX MONTHLY EARNINGS EXPERIENCE OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic$^@$						
Vocational-Academic	50**	(18)	46*	(18)	51	(27)
Vocational-Comprehensive	29**	(10)	51**	(10)	22	(15)
General	16	(13)	32**	(13)	19	(19)
Vocational-Technical	36**	(9)	55**	(9)	44**	(13)
Labor Market						
City A$^@$						
City B	-5	(8)	3	(8)	1	(12)
City C	3	(8)	-19*	(8)	33**	(12)
Male	169**	(7)	65**	(7)	287**	(11)
IQ	1.17**	(0.29)	0.87*	(0.29)	1.32**	(0.42)
White	48**	(10)	88**	(10)	4	(15)
Marital Status						
Married$^@$						
Single	43	(8)	-9	(8)	96**	(11)
Separated, Widowed, Divorced	-11	(36)	-44	(36)	24	(52)
Father's Education	-0.32	(1.10)	-0.57	(1.10)	-0.15	(1.62)
Number of Observations	1,255		1,255		1,255	
Coefficient of Determination#	0.33		0.15		0.39	
Intercept	16	(33)	13	(33)	-9	(49)
Standard Error of Estimate	111		112		164	
Mean of Dependent Variable	209	(70)	172	(85)	186	(133)
F-Ratio:						
All Variables	51.03**		18.65**		67.57**	
Curriculum	4.94**		10.28**		3.28**	
Labor Market	0.36		3.34**		4.00**	
Marital Status	15.68**		1.38		35.49**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

TABLE 29

PERCENT OF TIME EMPLOYED FOR NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	9.9*	(4.0)	10.6*	(4.2)	11.5	(6.3)
Vocational-Comprehensive	5.2*	(2.2)	12.6**	(2.6)	3.4	(3.5)
General	3.2	(2.7)	7.4*	(3.2)	1.3	(4.4)
Vocational-Technical	7.5**	(1.9)	14.2**	(2.3)	10.1**	(3.1)
Labor Market						
City A@						
City B	-1.5	(1.7)	1.0	(2.0)	1.2	(2.8)
City C	-4.6*	(1.8)	-10.5**	(2.3)	1.1	(2.9)
Male	19.7**	(1.6)	2.2	(1.9)	40.8**	(2.6)
IQ	0.14*	(0.06)	0.14	(0.07)	0.17	(0.09)
White	5.9**	(2.1)	21.3**	(2.5)	-10.9**	(3.4)
Marital Status						
Married@						
Single	15.5**	(1.6)	-3.05	(2.0)	34.8**	(2.6)
Separated, Widowed, Divorced	-2.8	(7.6)	-26.11**	(9.0)	10.7	(12.1)
Father's Education	-0.15	(0.23)	-0.51	(0.28)	-0.00	(0.37)
Number of Observations	1,255		1,255		1,255	
Coefficient of Determination#	0.18		0.11		0.28	
Intercept	47.2	(7.2)	44.6	(8.4)	33.9	(11.4)
Standard Error of Estimate	23.9		28.2		38.1	
Mean of Dependent Variable	77.9	(26.4)	80.3	(29.9)	67.0	(44.7)
F-Ratio:						
All Variables	23.61**		13.83**		40.25**	
Curriculum	4.81**		10.54**		3.82**	
Labor Market	3.23**		12.97**		0.12	
Marital Status	43.76**		5.29**		86.75**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE 30

NUMBER OF WEEKS NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES TOOK TO FIND THEIR FIRST JOB, CITIES A, B, AND C, IN WEEKS

Variable	Male and Female Graduates		Male Graduates		Female Graduates	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	-9.6**	(3.3)	-8.4	(5.6)	-5.4*	(2.4)
Vocational-Comprehensive	-10.4**	(1.8)	-12.0**	(3.7)	-10.6**	(2.0)
General	-5.1*	(2.3)	-6.6*	(2.8)	-4.2	(3.0)
Vocational-Technical	-11.1**	(1.6)	-9.6**	(2.8)	-11.1**	(1.9)
Labor Market						
City A@						
City B	1.1	(1.4)	0.2	(2.9)	-0.6	(1.4)
City C	6.3**	(1.5)	6.2*	(2.8)	4.4**	(1.6)
Male	-1.4	(1.3)	--c		--c	
IQ	-0.004	(0.05)	-0.13	(0.09)	-0.11	(0.06)
White	-12.2**	(1.8)	-1.6	(3.7)	-6.1**	(1.4)
Marital Status						
Married@						
Single	1.9	(1.4)	-2.5	(2.5)	3.9**	(1.5)
Separated, Widowed, Divorced	5.4	(6.3)	-0.4	(10.4)	3.3	(2.5)
Father's Education	0.28	(0.19)	0.78*	(0.36)	0.01	(0.21)
Number of Observations	1,255		322		933	
Coefficient of Determination#	0.09		0.08		0.08	
Intercept	28.9	(6.0)	24.0	(10.8)	34.1	(7.0)
Standard Error of Estimate	19.9		18.8		20.5	
Mean of Dependent Variable	10.6	(20.8)	9.8	(19.3)	10.9	(21.2)
F-Ratio:						
All Variables	10.82**		2.57**		7.27**	
Curriculum	13.72**		3.69**		10.62**	
Labor Market	8.99**		2.54**		3.92**	
Marital Status	1.24		--c		--c	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- c This variable is not relevant for this sample.
- # Adjusted for degrees of freedom.

If we impute the graduates first year average weekly earnings as their weekly opportunity cost for job search, we will obtain the following comparison of money values of opportunity cost for job search among the five curricula, given the same socio-demographic conditions: vocational-technical graduates, in general, had earned $737 ($67 x 11) before academic graduates started their jobs, while vocational-comprehensive and vocational-academic had earned $660 ($66 x 10) and $640 ($64 x 10), respectively, before academic graduates started their jobs. Finally, general curriculum graduates had earned $325 ($65 x 5) before academic graduates started their jobs.

It is also of interest to note that nonwhite graduates took 12 weeks more to get their first job than white graduates. Male graduates took one week less to get their job than females, although the difference is not statistically significant. Table 30 also shows the regression results in which separate male and female samples are presented.

3) During the sixth year after graduation, the set of dummy regressors for the curriculum variables is statistically significant at the .01 level. However, only the difference between vocational-technical and academic graduates is statistically significant. The employment of vocational-technical graduates is 10 percentage points (or 1.2 months) more than academic graduates.

4) The equation of percent of time of employment during the entire six-year period is also consistent with the findings of the earnings equations. The results indicate that vocational-technical graduates were employed 7 percentage points (or 4.3 months) more than the academic graduates.

5) The effects of graduate's sex, IQ, race, labor market location, marital status, and father's education on employment experience are also similar to earnings experiences. Therefore, no further discussions will be made of these variables. Appendix V, Tables IV, V, and VI present the employment experience of non-college high school graduates by cities.

D. Other Independent Variables Related to Earnings and Employment

There are a few important variables we have so far ignored in the study, such as relation of training to the first job graduates obtained, total number of training related jobs held after graduation, post-high school training programs, and kinds of occupation held after graduation.

The training relatedness to the first job after graduation is only relevant to the graduate's first year labor market experience. We have introduced this variable in the first year earnings and employment equations. In Table VII of Appendix V, the value of 1 is assigned to those graduates who acknowledged the training relatedness of their education to their jobs and 0 if otherwise. Results show that this variable is statistically significant at the .01 level in both equations. During the first year after graduation an additional $54 per month more was earned by graduates who had training related jobs than by those graduates whose first job was not training related. Training relatedness also increases employment 10 percentage points more (1.2 months) than those graduates whose first job was not training related.

The variable of total number of training related jobs held after graduation is introduced to equations of earnings and employment during the six-year period. In Appendix V, Table VIII, the results indicate that this variable is not statistically significant in the earnings equation, but it is significant in the employment equation. For each additional training related job that a graduate held, employment increases an additional 2.4 percentage points (or 6 weeks).

In Appendix V, Tables IX and X, a dummy variable is introduced in the regression equation to indicate whether or not a graduate has completed a post-high school training program after graduation. This variable is not statistically significant in either equation for earnings and employment for the six-year period. But over the first year after graduation, for those who have had post-high school training, both earnings and employment are less than otherwise, by $44 per month and 6 weeks. These values are statistically significant at the .01 level. On the other hand, during the sixth year period, those who have had post-high school training have earned $33 more per month and been employed 2 more weeks. These values are also statistically significant at the .01 level. The statistical results indicate that investment in on-the-job training will pay off in the long-run, even though there is a reduction in income in the short-run. The exact rate of return to post high school training is not available due to the lack of data on training costs.

Finally, while these above new variables are introduced in both the earnings and employment equations, the magnitude and statistical significance of curricular variables remain almost the same. The discussions in Section C of the differences of earnings and employment among five types of curricula are still relevant.

Also, a set of dummy regressors for the variable representing the type of occupation that the graduates held longest during the sixth year after graduation is introduced in the earnings and employment equations. None of the regressors is statistically significant. The nonsignificance may be attributed to sex, curriculum, and race variables, since occupation is highly correlated with sex, curriculum, and race. The specific statistical results will not be presented.

E. Other Dependent Variables Related to Earnings and Employment

There are a few important dependent variables which relate to economic benefits.

Relation of Training to Employment. It is assumed that those graduates who found jobs most closely related to their training, other things equal, should fare better in terms of employment and earnings as well as in terms of job satisfaction. Thus, it is important to establish whether or not the vocational-technical graduates whose training is generally more skill specific than the training of the graduates from the comprehensive senior high school, were more likely to succeed in acquiring jobs which were related to their training. Next, it is important to determine if the net returns were less to vocational-technical graduates who did not get a training related job relative to those vocational-technical graduates who did get a training related job. Table XI of Appendix V indicates that there was no net statistically significant difference in the number of jobs held between the academic and all other curricula. There are both positive and negative reasons why a person might have held numerous jobs. For instance, he may just be a drifter, he may work in the construction trades or he may be a highly mobile person who responds readily to differential net advantages among jobs. No information in this study allows us to distinguish reasons why a person has had a specific number of jobs.

The relationships between curriculum and training relatedness of the first job held after graduation is statistically significant at the .01 level of significance. In addition, vocational-technical graduates were 35 percent more likely to get a training related first job after graduation than were academic graduates. Of course, this effect is partially due, no doubt, to the fact that high school graduates who don't go to college tend to get jobs in industry and trade. Therefore, a graduate who has had any vocational training at all has a better chance, other things equal, of getting a training related job than a graduate who has had no vocational training since the vocational-technical skills are directly related to specific job classes in industry. Nevertheless, even those graduating from the general curriculum are 20 percent more likely to get a job which was highly or moderately related to their training than were the academic graduates. The difference is significant at the .01 level.

Males were 23 percent less likely to get a training related job for their first employment than were females. The difference is statistically significant at the .01 level. The reason probably lies in the differential type of training held by men and women. Women are disproportionately represented in the sample. High proportions of women tend to take commercial and stenographic courses. High proportions of women also tend to get jobs in this area. Thus, the interactions between sex and courses are most likely accounting for the observed differences. Finally, whites are about 23 percent more likely to hold a training related job for their first job than are nonwhites. Though one cannot be absolutely certain it is obvious to speculate that racial discrimination especially in the building trades may account in part for this phenomenon. However, again, there is a preponderance of female whites in the sample who are trained in clerical and stenographic skills so that the interaction between sex and skill may again be operating.

In terms of total number of jobs held, the vocational-technical graduate held approximately one more training-related job than did the academic graduate. The same is true of the vocational-comprehensive graduate. The differences are statistically significant at the .01 level of significance.

Voluntary Non-Labor Force Experience. National income accounting assumptions were followed in the coding of earnings in this study. That is, household production by persons who have voluntarily left the labor force has not been counted as an economic output. The effect of this is that while persons who voluntarily leave the labor force are in many cases still engaged in productive activity in the household (as distinct from the market) sector, this production is not measured in the returns to education. It is of interest to determine, therefore, if there is any net difference in voluntary non-labor force participation among graduates in the different curricula so as to determine if any major bias exists in the measure of earnings differentials among the curricula.

As it turns out, over the six-year period, there is no statistically significant difference in the percentage of non-labor force participation between the academic curriculum and the vocational-technical curriculum as shown in Appendix V, Table XII. However, for the first year after graduation, vocational-technical graduates experienced 8 percentage points or .96 months less voluntary withdrawal from the labor force than did the academic graduates. This implies that the measured net earnings benefit differentials between vocational-technical and academic graduates is overstated for the first year after graduation, since the academic graduates who have voluntarily withdrawn from the labor market can be considered to be producing at least some economic output. Likewise, the net employment benefit is overestimated since withdrawal from the labor force does not imply that a person is unemployed. But, by the time the sixth year after graduation arrives, there is no statistically significant difference in non-labor force participation between the graduates of the academic and the other curricula.

The partial regression coefficients for the sex variable show the expected relationships. For the first year after graduation, there is no statistically significant difference between males and females. But in the sixth year the difference in non-labor force participation is significant at the .01 level. By the sixth year after graduation women most likely have time to get married and have small children. Thus, women are voluntarily out of the labor force 3.7 months more than are men in the sixth year after graduation. The bias due to the national income account measure of benefits used in this study which excludes household production from being included in gross national product should not lead one to conclude that household production is trivial in its impact on the economy or that efficiency in household production is not just as necessary as efficiency in market production.

During the first year after graduation whites experience 17.7 percentage points (2.1 months) less voluntary labor force withdrawal than nonwhites but in the sixth year after graduation, whites experience 9.4 percentage points (1.1 months) more voluntary labor force withdrawal than do nonwhites. The answer to this lies in the sex-race composition of the study sample. Most of the members of the sample are white and are women. These white women heavily enter the labor force during the first year after graduation and heavily withdraw over time as they marry and rear children. In short, there is residual interaction between the sex and race variable, so that the race variable is also partially measuring the effect of sex.

F. Male and Female Graduates

The discussions in Section C suggest that the sex variable has affected levels of earnings and employment among graduates. In fact, male and female students after graduation have different labor force experience, due to factors such as military training which is mainly limited to male graduates. The different sex composition among the five types of curricula may also effect the performance of graduates in the labor market and affect the differences between curricula.

Due to the fact of interaction between sex and other variables, it is necessary to estimate earnings and employment equations separately in order to overcome this phenomenon. Tables 31 and 32 present before-tax earnings of male and female graduates, and Tables 33 and 34 present employment of male and female graduates.

Before-Tax Earnings. The sign and magnitude of regression coefficients for both male and female graduates are consistent except that the sign of marital status regressors in the male equations are different from the sign in the female equations.

It is now quite clear that the reason that single graduates earned more than married graduates, in the combined male and female equations, Table 26, is due to the fact that married female graduates choose to stay outside of the labor market. Table 31 shows that married male graduates earned more than single males, while Table 32 shows that married female graduates earned less than single female graduates.

The reason that white graduates earned less during the six-year period, as shown in Table 26, is due to the fact that married white female graduates choose to stay home and engage in household production while nonwhite females tend to stay in the labor market even after marriage. White male graduates still earned $135 per month more than nonwhite male graduates.

Female vocational-technical graduates have the highest monthly earnings among five types of female graduates during the six-year period while male vocational-technical graduates have the second highest monthly earnings among male graduates during the six-year period. The absolute differences among the five types of male graduates are, in general, larger than the differences among female graduates.

Employment. Tables 33 and 34 present the employment experiences of male and female graduates. Again, the sign and statistical significance of both male and female employment equations are consistent with the male and female earnings equations, respectively. During the first year after graduation, there were statistically significant differences in employment among the five types of graduates, both male and female. Furthermore, academic graduates, both male and female, had shorter employment periods. However,

TABLE 31

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF MALE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	-6	(46)	57	(51)	-54	(54)
Vocational-Comprehensive	63*	(31)	103**	(34)	56	(36)
General	15	(28)	58	(31)	15	(32)
Vocational-Technical	43	(23)	77**	(26)	44	(27)
Labor Market						
City A@						
City B	-2	(20)	18	(22)	-5	(23)
City C	25	(23)	-44	(26)	98**	(27)
IQ	1.83*	(0.76)	1.95*	(0.85)	2.29*	(0.89)
White	136**	(30)	133**	(33)	125**	(35)
Marital Status						
Married@						
Single	-80**	(20)	-46**	(23)	-88 **	(24)
Separated, Widowed, Divorced	-63	(85)	-116	(94)	-140	(99)
Father's Education	-3.18	(2.97)	-3.06	(3.30)	-5.50*	(3.47)
Number of Observations	322		322		322	
Coefficient of Determination#	0.12		0.10		0.15	
Intercept	149	(89)	-21	(98)	218	(104)
Standard Error of Estimate	154		171		180	
Mean of Dependent Variable	443	(165)	315	(181)	534	(196)
F-Ratio:						
All Variables	5.20**		4.48**		6.35**	
Curriculum	1.52		2.98*		1.43	
Labor Market	0.68		2.33*		7.42**	
Marital Status	7.93**		2.67**		6.98**	

Notes:

* Significant at the .05 level

** Significant at the .01 level.

b is the partial regression coefficient.

(s) is the standard error of the partial regression coefficient.

@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.

# Adjusted for degrees of freedom.

TABLE 32

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF FEMALE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	-15	(14)	5	(13)	-38	(21)
Vocational-Comprehensive	13	(12)	39**	(11)	-10	(18)
General	2	(18)	8	(17)	-16	(27)
Vocational-Technical	34**	(12)	49**	(11)	36*	(17)
Labor Market						
City A@						
City B	0	(8)	-4	(8)	1	(12)
City C	9	(10)	-16	(9)	32*	(14)
IQ	1.95**	(0.36)	1.29**	(0.34)	2.13**	(0.53)
White	22*	(9)	52**	(8)	-21	(13)
Marital Status						
Married@						
Single	78**	(9)	5	(9)	159**	(14)
Separated, Widowed, Divorced	9	(15)	-24	(14)	-4	(22)
Father's Education	-0.09	(1.26)	1.10	(1.17)	-1.05	(1.83)
Number of Observations	933		933		933	
Coefficient of Determination#	0.10		0.08		0.15	
Intercept	-10	(43)	17	(40)	-31	(62)
Standard Error of Estimate	125		116		181	
Mean of Dependent Variable	250	(131)	237	(121)	216	(197)
F-Ratio:						
All Variables	10.41**		8.93**		17.09**	
Curriculum	3.71**		6.57**		4.93**	
Labor Market	0.45		1.66*		2.48**	
Marital Status	47.68**		0.41		95.17**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE 33

PERCENT OF TIME EMPLOYED FOR MALE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	-2.4	(4.0)	28.4**	(8.0)	-9.6*	(4.5)
Vocational-Comprehensive	5.1	(2.7)	14.5**	(5.4)	1.5	(3.0)
General	1.3	(2.4)	8.7*	(4.9)	-1.4	(2.7)
Vocational-Technical	2.4	(2.0)	12.3**	(4.1)	1.1	(2.3)
Labor Market						
City A@						
City B	-0.8	(1.7)	2.6	(3.4)	1.8	(1.9)
City C	-3.1**	(2.1)	-4.1	(4.0)	2.2	(2.3)
IQ	0.17**	(0.06)	0.26*	(0.13)	0.20**	(0.07)
White	2.8	(2.6)	12.6*	(5.3)	-0.7	(3.0)
Marital Status						
Married@						
Single	-1.6	(1.8)	-1.0**	(3.6)	-2.0	(2.0)
Separated, Widowed, Divorced	-3.6	(7.4)	1.6**	(14.9)	-5.2	(8.4)
Father's Education	-0.68**	(0.25)	-1.17*	(0.52)	-0.59*	(0.29)
Number of Observations	322		322		322	
Coefficient of Determination#	0.16		0.18		0.15	
Intercept	77.2	(7.8)	45.4	(15.6)	81.3	(8.7)
Standard Error of Estimate	13.5		27.0		15.1	
Mean of Dependent Variable	92.1	(14.7)	82.7	(30.1)	96.4	(16.5)
F-Ratio:						
All Variables	6.61**		7.85**		6.25**	
Curriculum	1.22		4.80**		1.61*	
Labor Market	1.17		1.09		0.70	
Marital Status	0.85		2.46**		0.64	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

TABLE 34

PERCENT OF TIME EMPLOYED FOR FEMALE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	5.9	(3.2)	21.1**	(3.8)	17.8**	(5.0)
Vocational-Comprehensive	7.5**	(2.7)	17.4**	(3.2)	-1.1	(4.2)
General	5.1	(4.0)	10.2*	(4.8)	-4.2	(6.3)
Vocational-Technical	8.7**	(2.5)	20.0**	(3.0)	12.5**	(4.0)
Labor Market						
City A@						
City B	6.3**	(1.8)	0.9*	(2.2)	-9.5**	(2.8)
City C	1.8	(2.1)	-9.4*	(2.6)	-8.0*	(3.4)
IQ	0.34**	(0.08)	0.14	(0.09)	0.11	(0.12)
White	-4.6*	(1.9)	15.4**	(2.3)	-11.7**	(3.0)
Marital Status						
Married@						
Single	14.2**	(2.0)	3.4	(2.4)	56.9**	(3.2)
Separated, Widowed, Divorced	-11.8**	(3.3)	-17.2**	(4.0)	-10.7*	(5.2)
Father's Education	-0.58*	(0.27)	2.21**	(0.33)	1.25**	(0.43)
Number of Observations	933		933		933	
Coefficient of Determination#	0.09		0.20		0.33	
Intercept	34.8	(9.3)	15.9	(11.2)	29.2	(14.7)
Standard Error of Estimate	27.3		32.6		42.9	
Mean of Dependent Variable	72.9	(28.6)	80.5	(36.6)	57.2	(52.9)
F-Ratio:						
All Variables	9.31**		22.93**		44.90**	
Curriculum	3.52*		16.40**		6.73**	
Labor Market	6.28**		7.07**		7.92**	
Marital Status	54.76**		3.29**		99.74**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

during the sixth year after graduation, academic graduates were not uniformly employed less time than other types of graduates. The absolute differences in employment period among the five types of male graduates during the sixth year period are much less than the differences among female graduates. It is conceivable that the marriage factor explains the differences. The coefficients of the marital status regressors further support the explanation of earning differences between male and female graduates, that is, single females have more time employed than married females, while there is no difference in time employed between single males and married males.

There are two important variables related to the sex variable that have so far not been included in the model. Military experience is related to male graduate civilian labor force participation and voluntary withdrawal from the labor force due to marriage is related to female graduates. The military training variable was included in the male graduate equation. Both earnings and employment equations show that military training does not have a statistically significant effect on the dependent variables. In part, this is due to the fact that the time spent in the military was excluded when earnings and employment were coded. This coding procedure controlled for military experience to a large degree.

Some female graduates tend to be voluntarily not in the labor force after marriage while some are not. This information about voluntary non-labor force participation is very necessary to explain the differences in labor market performance among female graduates toward the later part of the period after graduation.

Tables XIII and XIV of Appendix V show the regression results of female graduates excluding the voluntary not in the labor force samples. Earnings and employment of female vocational-technical graduates are still higher compared to academic graduates and are statistically significant. The results are consistent with the findings in Tables 32 and 34.

G. White and Nonwhite Graduates

Due to the fact of interaction between race and other socio-economic variables, it is necessary to estimate earnings and employment equations separately on the basis of race. Tables 35 and 36 present before tax earnings of white and nonwhite graduates, and Tables 37 and 38 present employment of white and nonwhite female graduates.

TABLE 35

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCES OF WHITE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	54*	(24)	56*	(23)	46	(33)
Vocational-Comprehensive	42**	(14)	68**	(13)	26	(19)
General	18	(17)	35*	(16)	11	(23)
Vocational-Technical	47**	(12)	67**	(11)	50**	(16)
Labor Market						
City A@						
City B	-2	(11)	6	(10)	-8	(15)
City C	10	(11)	-26	(11)	48**	(15)
Male	210**	(10)	86**	(9)	346**	(14)
IQ	1.26**	(0.39)	1.15**	(0.37)	1.58**	(0.54)
Marital Status						
Married@						
Single	46**	(11)	-9	(10)	122**	(15)
Separated, Widowed, Divorced	30	(50)	-16	(47)	71	(68)
Father's Education	0.28	(1.49)	-0.08	(1.42)	-0.18	(2.04)
Number of Observations	1,099		1,099		1,099	
Coefficient of Determination#	0.31		0.10		0.41	
Intercept	73	(47)	84	(45)	-20	(64)
Standard Error of Estimate	140		133		191	
Mean of Dependent Variable	309	(168)	272	(140)	300	(249)
F-Ratio:						
All Variables	45.02**		11.93**		70.53**	
Curriculum	4.63**		10.34**		2.72**	
Labor Market	0.58		4.44**		6.48**	
Marital Status	9.43		0.44		35.24**	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE 36

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCES OF NONWHITE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	45	(58)	25	(65)	110	(82)
Vocational-Comprehensive	-9	(28)	-15	(32)	6	(40)
General	-2	(40)	-17	(45)	36	(56)
Vocational-Technical	46	(26)	20	(29)	91*	(36)
Labor Market						
City A@						
City B	-3	(21)	-45	(24)	52	(30)
City C	12	(25)	23	(27)	46	(34)
Male	116**	(22)	36	(25)	173*	(31)
IQ	2.60**	(0.70)	0.69	(0.78)	2.83**	(0.99)
Marital Status						
Married@						
Single	56**	(18)	-9	(20)	90**	(25)
Separated, Widowed, Divorced	-63	(77)	-140	(86)	-58	(109)
Father's Education	-1.33	(2.86)	-2.46	(3.19)	1.31	(4.02)
Number of Observations	156		156		156	
Coefficient of Determination#	0.25		0.04		0.27	
Intercept	-71	(80)	120	(89)	-138	(112)
Standard Error of Estimate	104		116		147	
Mean of Dependent Variable	234	(120)	158	(118)	286	(171)
F-Ratio:						
All Variables	5.41**		1.44		5.93**	
Curriculum	2.22**		0.72		2.99**	
Labor Market	0.16		1.86*		1.88*	
Marital Status	5.55**		1.35		6.78**	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE 37

PERCENT OF TIME EMPLOYED FOR WHITE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITIES, A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	8.5*	(4.1)	9.8*	(4.6)	10.2	(6.7)
Vocational-Comprehensive	6.8**	(2.3)	15.0**	(2.6)	4.3	(3.8)
General	2.4	(2.8)	7.9*	(3.2)	0.1	(4.6)
Vocational-Technical	8.0**	(2.0)	15.5**	(2.3)	9.9**	(3.3)
Labor Market						
City A@						
City B	-2.1	(1.8)	0.3	(2.1)	-1.0	(3.0)
City C	-3.8*	(1.9)	-9.7**	(2.1)	1.5	(3.1)
Male	19.7**	(1.7)	1.4	(1.9)	42.5**	(2.7)
IQ	0.11	(0.06)	0.19*	(0.07)	0.15	(0.10)
Marital Status						
Married@						
Single	15**	(1.8)	-3.8	(2.0)	35.6**	(3.0)
Separated, Widowed, Divorced	5.8	(8.5)	-16.8	(9.5)	19.9	(13.7)
Father's Education	0.01	(0.25)	-0.32	(0.28)	0.01	(0.41)
Number of Observations	1,099		1,099		1,099	
Coefficient of Determination#	0.18		0.08		0.28	
Intercept	53.6	(8.0)	57.2	(8.9)	24.5	(13.0)
Standard Error of Estimate	23.7		26.6		38.6	
Mean of Dependent Variable	78.4	(26.1)	82.9	(27.6)	65.3	(35.3)
F-Ratio:						
All Variables	22.09**		8.63**		39.18**	
Curriculum	4.66**		13.28**		3.16**	
Labor Market	2.08		12.16		0.[illegible]6	
Marital Status	34.93**		3.31**		73.27**	

Notes:

- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE 38

PERCENT OF TIME EMPLOYED BY NONWHITE NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, IN CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	19.9	(13.6)	18.8	(21.0)	25.5	(19.2)
Vocational-Comprehensive	-3.0	(6.6)	2.5	(10.2)	-1.0	(9.3)
General	8.0	(9.4)	2.3	(14.5)	10.9	(13.2)
Vocational-Technical	5.5	(6.0)	5.0	(9.4)	12.4	(8.5)
Labor Market						
City A[@]						
City B	4.8	(5.0)	-10.2	(7.7)	17.7*	(7.0)
City C	-11.2	(5.7)	-16.9*	(8.9)	-1.4	(8.1)
Male	21.8**	(5.2)	12.6	(8.0)	25.8**	(7.3)
IQ	0.27	(0.16)	-0.18	(0.25)	0.29	(0.23)
Marital Status						
Married[@]						
Single	16.8**	(4.2)	2.2	(6.4)	27.3**	(5.9)
Separated, Widowed, Divorced	-33.7	(18.0)	-68.2*	(27.9)	-19.7	(25.4)
Father's Education	-1.16	(0.66)	-1.84	(1.03)	-0.03	(0.94)
Number of Observations	156		156		156	
Coefficient of Determination[#]	0.23		0.06		0.02	
Intercept	44.4	(18.7)	94.6	(28.9)	23.8	(26.4)
Standard Error of Estimate	24.4		37.7		34.4	
Mean of Dependent Variable	73.8	(27.7)	62.0	(38.4)	78.7	(38.3)
F-Ratio:						
All Variables	5.50**		1.56*		4.36**	
Curriculum	1.37		0.23		1.42	
Labor Market	3.13**		2.16**		3.58**	
Marital Status	10.68**		3.14**		11.57**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

Before-Tax Earnings. There is a distinct difference between the earnings equations of white and nonwhite graduates. Statistically, there are fewer significant independent variables to explain the variations of nonwhite graduate earnings and employment than there are for the equation of white graduates. Nonwhite vocational-technical graduates do not earn more than nonwhite academic graduates except during the sixth year period.

On the contrary, white vocational-technical graduates earn more than white academic graduates throughout the whole six-year period. White male graduates earn much more than white females and the difference is consistently higher than the differences between nonwhite male and nonwhite females. In other words, nonwhite male graduates do not have as much advantage as white male graduates have over their respective female counterparts in the labor market.

Employment. Equations of white graduates indicate the variable for curriculum is statistically significant, while equations of nonwhite graduates show the curriculum variable is not statistically significant. These results imply that there is no difference in employment in terms of type of curriculum for a nonwhite graduate. For the study sample, this implies that employment opportunities are equally good (or equally unfavorable) for nonwhites regardless of curriculum. It also implies that the state of being nonwhite, in conjunction with the other variables in the model, overrides the possible differential positive effects of the curriculum variable.

H. Vocational-Technical High School Graduates

Within the vocational-technical curriculum, we have classified 12 specialized courses in which graduates have majored. These are commercial, food service, building trades, mechanical and repair, tool design, wood working, electrical and electronics, agriculture and horticulture, other professional and semi-skilled, distributive education, personal services, and clothing and fabrics. It is worthwhile to evaluate a graduate's labor market performance within the vocational-technical curriculum and to measure the differences of earnings and employment due to the courses that graduates have specialized in.

Tables 39 and 40 present empirical estimates of earnings and employment of vocational-technical graduates by course area. Under the course category, the dummy regressor of commercial is omitted and its value has entered into the intercept term. In interpreting the results, it is important to remember that high proportions of females enroll in this course area.

TABLE 39

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCES OF NON-COLLEGE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial@						
Food Service	-21	(44)	-70	(41)	-16	(59)
Building Trades Occupations	-87	(76)	-36	(71)	-166	(101)
Mechanical and Repair	4	(38)	-58	(36)	45	(51)
Tool Design	98*	(38)	94**	(36)	110*	(52)
Wood Working Occupations	51	(52)	-21	(48)	69	(69)
Electrical and Electronics	8	(40)	-0	(37)	8	(53)
Agriculture and Horticulture	34	(103)	-108	(96)	140	(138)
Professional Occupations	26	(28)	-30	(26)	79	(37)
Distributive Education	-49	(64)	3	(60)	-71	(85)
Personal Services	-85**	(33)	-75*	(31)	-84*	(44)
Clothing and Fabrics	-23	(44)	11	(41)	-49	(59)
Labor Market						
City A@						
City B	-3	(15.31)	-9	(14)	4	(20)
City C	6	(14.82)	-33*	(14)	45*	(20)
Male	164**	(25.95)	76**	(24)	273**	(35)
IQ	1.03	(0.61)	1.13*	(0.57)	0.53	(0.82)
White	40*	(18.70)	91.20**	(18)	-28	(25)
Marital Status						
Married@						
Single	51**	(14.47)	-10	(14)	123**	(19)
Separated, Widowed Divorced	119	(99.62)	46	(93)	232	(133)
Father's Education	3.11	(2.19)	1.65	(2.06)	5.75*	(2.93)
Number of Observations	565		565		565	
Coefficient of Determination#	0.29		0.16		0.38	
Intercept	85	(66)	60	(62)	114	(88)
Standard Error of Estimate	140		131		187	
Mean of Dependent Variable	310	(165)	268	(142)	317	(235)
F-Ratio:						
All Variables	12.59**		6.22**		18.38**	
Curriculum	1.83*		2.64**		1.44	
Labor Market	0.17		2.94**		2.91**	
Marital Status	6.74**		0.39		21.43**	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE 40

PERCENT OF TIME EMPLOYED FOR NON-COLLEGE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial@						
Food Service	-5.8	(7.3)	-13.6	(8.3)	-4.4	(11.8)
Building Trades Occupations	-3.3	(12.6)	15.5	(14.2)	-18.6	(20.4)
Mechanical and Repair	-2.2	(6.4)	-8.4	(7.2)	2.2	(10.3)
Tool Design	1.4	(6.5)	0.3	(7.3)	8.2	(10.5)
Wood Working Occupations	2.7	(8.6)	-7.8	(9.7)	9.0	(13.9)
Electrical and Electronics	2.8	(6.6)	-6.8	(7.5)	1.9	(10.7)
Agriculture and Horticulture	4.5	(17.2)	-18.5	(19.3)	-0.8	(27.7)
Professional Occupations	-2.4	(4.6)	-4.6	(5.2)	5.9	(7.4)
Distributive Education	-6.0	(10.6)	16.2	(11.9)	-22.1	(17.1)
Personal Services	-10.8	(5.5)	-4.4	(6.2)	-0.2	(8.8)
Clothing and Fabrics	-8.8	(7.4)	6.5	(8.3)	-21.6	(11.9)
Labor Market						
City A@						
City B	-2.4	(2.6)	-3.0	(2.9)	1.8	(4.1)
City C	-6.0*	(2.5)	-14.0*	(2.8)	0.3	(4.0)
Male	17.3**	(4.3)	4.0	(4.9)	31.5**	(7.0)
IQ	0.10	(0.10)	0.21	(0.11)	-0.17	(0.16)
White	3.4	(3.1)	20.4**	(3.5)	-13.8**	(5.0)
Marital Status						
Married@						
Single	15.4**	(3.4)	-5.1	(2.7)	34.0**	(3.9)
Separated, Widowed Divorced	24.4	(16.6)	4.8	(18.7)	46.0	(26.8)
Father's Education	0.50	(0.36)	-0.07	(0.41)	0.91	(0.59)
Number of Observations	565		565		565	
Coefficient of Determination#	0.17		0.13		0.25	
Intercept	66.7	(11.0)	50.8	(12.4)	75.8	(17.8)
Standard Error of Estimate	23.4		26.3		37.8	
Mean of Dependent Variable	79.8	(25.4)	83.3	(27.9)	71.7	(43.2)
F-Ratio:						
All Variables	6.30**		4.69**		10.23**	
Curriculum	0.59		1.01		0.71	
Labor Market	3.00**		13.45**		0.09	
Marital Status	21.10**		1.82 *		39.00**	

Notes:

- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

Before-Tax Earnings. Among these specialized courses, only the differences between commercial vis-a-vis tool design and personal services are statistically significant. The coefficients of these two dummy regressors indicate that tool design graduates earned $98 per month more than commercial graduates during the six-year period after graduation. In fact, relative to the commercial course area, tool design graduates earned more than most of the other graduates in the vocational-technical curriculum. On the other hand, personal services graduates have earned $85 per month less than commercial graduates during the six-year period after graduation. In fact, personal services graduates have earned less than most of the other graduates in the vocational-technical curriculum.

Table 39 shows that the earnings differences classified according to courses are statistically significant at the .01 level during the first year after graduation, but this classification is not statistically significant for the sixth year after graduation. The differences in the statistics show that the effect on earnings of training in specific courses tends to decline as years go by. This phenomenon is consistent with results among the differences in the five curricula as shown in Table 26.

Employment. The employment experiences of vocational-technical graduates are shown in Table 40. Statistically, there are no differences among specialized courses that graduates have majored in. Furthermore, the classification of specialized courses are also not statistically significant.

Male and Female Vocational-Technical Graduates. There are certain vocational-technical courses designed for male students while others are designed for female students. Therefore it is meaningful to separate male and female vocational-technical graduates and estimate their respective labor market performances. Tables XV to XVIII of Appendix V present earnings and employment experiences of male and female vocational-technical graduates. Among male vocational-technical graduates, only earnings of tool design graduates are statistically significantly higher than other vocational-technical male graduates. Among female graduates, only earnings of personal services graduates are statistically significantly lower than other vocational-technical female graduates. As far as amount of time employed is concerned, the variable of specialized courses is not statistically significant in either the male or the female vocational-technical graduate equations.

I. Summary

Earnings and employment are chosen as measurable economic indices of non-college senior high school graduates' labor market performance. In order to estimate the net effect of a graduate's curriculum on his labor market performance, it is necessary to control for differences in socio-demographic variables among the graduates.

The statistical findings show that vocational-technical graduates have earned more and been employed for a longer period than academic graduates during the six years after graduation. The differences are statistically significant. Further examination by sex interaction and race interaction results still indicate that vocational-technical graduates have better labor market performance than academic graduates.

Within the curriculum of vocational-technical graduates, there is no difference in employment by specific course. But in terms of earnings relative to the commercial course, tool design has higher earnings than other course areas while personal services has lower earnings. This finding continues to be the case for separate analysis of males and females.

CHAPTER IX

VOCATIONAL-TECHNICAL EDUCATION AS AN INVESTMENT

A. Introduction

The qualifications to the economic analysis of vocational-technical and other types of education are discussed in Chapter III. The specific qualifications to the investment criteria are discussed in Chapter IV. Given these qualifications, it is possible to analyze vocational-technical education in terms of its value as an investment in the human agent. Chapter VII presents the necessary cost data to make an economic comparison between graduates from the vocational-technical curriculum and graduates from the curricula of comprehensive senior high schools for Cities A and C. The cost data for City B are inadequate for the purpose at hand. Except for one or two skill areas earnings differentials between vocational-technical and comprehensive senior high school graduates for matched skill areas are not statistically significant. No investment analysis by skill will be performed, therefore Appendix V, Tables XIX, XX and XXI show estimated benefit equations by skill.

Caution should be used in the interpretation of these measures of monetary return. Not only are the monetary measures an incomplete index of social costs and benefits, but the measured monetary costs and benefits themselves are incomplete.

B. Costs

The length of training for senior high school students for all curricula is three years. However, four cohorts of graduates exist--June and January, 1959 and 1960. To simplify the analysis the assumption was made that graduates in the sample all undertook their training during the 1957-58, 1958-59 and 1959-60 school years and were

June graduates. The justification for lumping the period of training into one specific period lies in the fact that variables to account for time of graduation in the benefit equations were not statistically significant.

For City A the school district contains comprehensive and vocational-technical senior high schools. Marginal costs per student in average daily attendance were estimated for each of these types of school. Vocational-academic graduates in City A graduated from vocational-technical high schools. For City C, the school district contains vocational-technical, vocational-academic and comprehensive senior high schools. Cost data for the vocational-technical and vocational-academic senior high schools were combined to estimate a single total cost and average cost function. A separate total and average cost function was estimated for the comprehensive senior high schools of City C. Unlike City A, in City C it is possible for students to major in any curriculum in any senior high school in the school district though the majority of students in the academic, general and vocational-comprehensive curricula come from the comprehensive senior high schools and the majority of vocational-technical and vocational-academic graduates come from their respective senior high schools. Nevertheless, due to this fact, some bias does exist in the cost data for City C which is not present in the cost data for City A. Different proportions of academic and vocational-technical students in the comprehensive schools will obviously bias the cost estimates, however. The direction of this bias is not known because the varying proportions for each school are not known. Finally, for each type of senior high school, the 10th, 11th, and 12th grades are all combined. If the average costs among the grades are different, the simplifying assumption above will impart a bias to the rates of return and other investment criteria herein.

Given these caveats, Table 41 presents the estimated cost and benefit streams for the study sample, based on current total costs. For the comprehensive senior high schools of City A, marginal costs based on a linear approximation are $304 for the pooled fiscal years of 1956-60. For vocational-technical schools in the same city marginal costs based on a linear approximation are $464. Thus, the undiscounted differences in marginal costs are $160. The respective figures for City C are $270, $386 and $116. The estimated costs are deflated with 1956 as the base. The pooled equation for the fiscal years 1956-60 is used to measure marginal costs over the 1957-60 years since it is felt that the underlying production function and, thus, cost function, has not changed significantly over this time period. Thus, the estimated marginal costs for the separate years are assumed to represent variations about the mean value as represented by the pooled equation. These annually fluctutating values are not felt, therefore, to be the most appropriate measures of the actual marginal cost underlying the relationship.

TABLE 41

COST-BENEFIT STREAM DIFFERENTIALS BASED ON TOTAL CURRENT COST BETWEEN COMPREHENSIVE AND VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL GRADUATES, CITIES A AND C, IN DOLLARS, DISCOUNTED AT 0, 6, AND 10 PERCENT,[1] (1955-56 = 100)

Time Period	Year[2]	City A[3]						City C[3]					
		Marginal Costs at Average ADA			Marginal Costs by Linear Approximation			Marginal Costs at Average ADA			Marginal Costs by Linear Approximation		
		0	6	10	0	6	10	0	6	10	0	6	10
1	1957-58	-156	-147	-142	-197	-186	-179	-116	-109	-105	-124	-117	-113
2	1958-59	-156	-139	-129	-197	-175	-163	-116	-103	-96	-124	-110	-102
3	1959-60	-156	-131	-117	-197	-165	-148	-116	-97	-87	-124	-104	-93
4	1960-61	343	300	258	343	300	258	643	562	484	643	562	484
5	1961-62	343	286	237	343	286	237	643	535	445	643	535	445
6	1962-63	343	273	218	343	273	218	643	511	409	643	511	409
7	1963-64	343	261	201	343	261	201	643	489	377	643	489	377
8	1964-65	343	250	186	343	250	186	643	468	348	643	468	348
9	1965-66	343	241	173	343	241	173	643	451	323	643	451	323

Source: Costs--Tables 20 and 21; Benefits-Tables 42 and 43.

Notes:

[1] City C costs are based upon pooled data for the vocational-technical and vocational-academic senior high schools.

[2] Marginal costs are based on data pooled for the fiscal years 1956 through 1960.

[3] Marginal cost differentials are negative in sign since they are considered to be negative benefits. Benefit differentials are positive.

C. Benefits

Benefits are based on the regression results shown in Table 42 and summarized in Table 41 for Cities A, B and C, respectively. Of course, since appropriate cost data are not available for City B, an investment evaluation cannot be done for this city. For City A (Table 42), the partial regression coefficient for the graduates of the vocational-technical curriculum shows that over the 1961-66 period vocational-technical graduates earned an average of $29 per month or $343 more on the average per year than the graduates from the three curricula of the comprehensive senior high school. The respective estimates for City C (Table 44) are $54 and $643. These estimated values are summarized in Table 41. They are represented only for the six-year period following graduation for two reasons. First, the period is limited to six years since the benefit streams of the graduates from the curricula of the two types of senior high school tend to converge, though not necessarily intersect, at or about the sixth year after graduation.[1] Secondly, the labor market information for the sample does not extend beyond six years after graduation.

D. The Investment Return: Total Current Costs

Several investment criteria have been used to represent measures of the investment return to vocational-technical education. Given the qualifications the real world imposes on each of these as pointed out in Chapter IV, none of these is necessarily preferred over the other as decision criteria. Table 43 displays these.

The ratio of discounted marginal benefit difference to discounted marginal cost difference has been computed between vocational-technical graduates and the graduates of comprehensive senior high schools. Fisher's rate of return has been computed. Given the way in which the benefit data have been estimated, these two measures are most correct. In addition, however, net present values, the benefit-cost ratio and the internal rate of return have been computed based on assumptions specified below. The relevant equations for all these criteria are in Chapter IV.

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1. If the two benefit streams actually intersect, then the existence of multiple rates of return is a possibility. If they converge asymtotically, then only one rate of return is possible for this data set. Given the data, it has not been possible to determine which of these two situations is the actual one.

TABLE 42

AVERAGE MONTHLY BEFORE TAX EARNINGS DIFFERENTIALS FOR GRADUATES OF THE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS VIS-A-VIS COMPREHENSIVE SENIOR HIGH SCHOOLS, CITIES A, B, AND C, IN DOLLARS

City and Curriculum[1]	Average in Six Years					First Year After Graduation					Sixth Year After Graduation				
	b (s)	I (s)	SEE	F	$\overline{R}^2$	b (s)	I (s)	SEE	F	$\overline{R}^2$	b (s)	I (s)	SEE	F	$\overline{R}^2$
City A[2] N = 649		-25 (50)	131	3.24*	.32*		49 (49)	130	3.44*	.14**		-127 (70)	184	3.45*	.39**
Vocational-Academic	19 (34)					-4 (33)					44 (47)				
Vocational-Technical	29* (11)					29** (11)					40* (16)				
City B N = 313		49 (78)	142	--	.30**		87 (72)	132	--	.18**		-40 (94)	172	--	.44**
Vocational-Technical[3]	21 (17)					18 (15)					49 (20)*				
City C N = 293		144 (85)	144	4.74**	.28**		30 (82)	138	5.02**	.07**		274 (123)	207	2.89	.37**
Vocational-Academic	76* (32)					56 (30)					76 (46)				
Vocational-Technical	54** (19)					58** (18)					63* (28)				

Notes:

*	Significant at the .05 level of significance.
**	Significant at the .01 level of significance.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
I	is the intercept.
N	is the number of observations.
SEE	is the standard error of the estimate.
F	is the F-statistic for the vocational-academic and vocational-technical curricula.
$\overline{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

[1] In addition to the variables shown, each regression equation includes the sex, race, IQ, marital status, and father's education.

[2] The partial regression coefficients are interpreted as deviations from the average experience of the graduates of the comprehensive senior high school.

[3] No vocational-academic curriculum for City B.

TABLE 43

ESTIMATED MEASURES OF NET INVESTMENT BENEFIT BASED ON TOTAL CURRENT COST FOR THE VOCATIONAL-TECHNICAL VIS-A-VIS THE COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES, CITY A AND CITY C

Criterion Measure	City A		City C	
	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
Ratio of Difference in Marginal Benefits to Difference in Marginal Costs				
6%	3.8	3.1	9.8	9.1
10%	3.2	2.6	8.3	7.8
Net Present Value[1]				
PV-I				
6%	$1,184	$1,085	$2,707	$2,685
10%	$ 876	$ 783	$2,098	$2,078
PV-II				
6%	$ 370	$ 264	$1,984	$1,923
10%	$ 119	$ 19	$1,426	$1,369
Benefit-Cost Ratio[2]				
6%	1.3	1.2	2.9	2.8
10%	1.1	1.0	2.3	2.4
Rates of Return[1]				
Rate I	42.4%	34.8%	85.7%	82.2%
Rate II	9.3%	7.2%	33.3%	31.3%

Source: Tables 20, 21 and 41.

Notes:

[1] PV-I is based on estimated differences in marginal costs and differences in marginal benefits. PV-II is based on the marginal cost estimations in Tables 20 and 21, for vocational-technical education. Benefits are based on the assumption that the benefit differentials in Table 41, are marginal benefits.

Rate I is based on estimated differences in marginal costs and differences in marginal benefits. It is Fisher's rate of return, the rate of return which equates cost and benefit differences between two different cost-benefit streams. Thus, it is also the rate at which the net present values of the two streams are equal.

Rate II is the internal rate of return and is based on the actual marginal cost estimations in Tables 20 and 21 and the assumption that the benefit differentials in Table 41 are marginal benefits. Given these assumptions, this measure is the internal rate of return, the rate of monetary profit on investing in vocational-technical education.

[2] The benefit-cost ratio is based on the assumption that the estimated benefits represent marginal benefits.

Ratio of Difference in Marginal Benefits to Difference in Marginal Costs. This criterion measure, the measure of differences in net present value, and Fisher's rate of return are the three measures which are most correct for the data of this study. The reason for this is that the benefits as measured are most accurately to be considered differences between the average performance of the graduates of the vocational-technical and comprehensive senior high schools. If one assumes that an additional graduate from either of these two types of high school will earn exactly what the average graduate earns, then the average benefit is equal to the marginal benefit and the estimated benefits can be assumed as differences between marginal benefits. With this assumption, it is possible to calculate the differences in marginal costs by simple subtraction and apply the investment criterion defined by equation (13) in Chapter IV.

Given these qualifications and the estimated differences shown in Table 41, the resulting ratios as shown in Table 43 for City A are 3.1 and 2.6 for 6 and 10 percent interest rates.[2] For City C, the respective ratios are 9.1 and 7.8. For both cities and for both interest rates used in discounting, this argues that additional public funds should be spent on vocational-technical students rather than students of comprehensive senior high schools. The qualification of the investment criteria indicated by equation (13) in Chapter IV is mentioned on page 45 ff.

Constraints. This is strictly true, however, under some fairly severe constraints. It holds only for the study sample of non-college attending high school graduates of City A and C. It assumes that the future or present will be identical to the past. Also, it assumes that the sub-samples of vocational-technical and comprehensive senior high school graduates are identical in every respect; that every student member of the total sample is indifferent between the vocational-technical and comprehensive senior high school curricula on non-economic grounds (there are no differential consumption benefits to be gained by a student pursuing one curriculum rather than the other); that neither of the two subsets of graduates will go to college (the option value of higher education is zero for both groups); and, finally, that monetary benefits are all that matter. The restrictions apply whatever criterion is used.

Differences in Net Present Value. For a given interest rate used in discounting, if a difference in net marginal present value exists between two investments, then that investment which the difference favors has the higher net marginal present value and is the preferred investment. As Table 43 shows for both City A and City C, at the 6 and 10 percent interest rates, there is a net marginal present value difference (PVI) in favor of graduates from the vocational-technical curriculum. Thus, at these interest rates, the vocational-technical curriculum has a higher net marginal present value than the average of the three curricula of the comprehensive senior high schools. And so the preferred investment at these interest rates is the vocational-technical curriculum.

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[2] In this and subsequent analysis, the criterion measures stated refer to marginal costs by linear approximation. The implications of the analysis by using marginal costs estimated at average ADA are identical and stating them would be repetitious.

Fisher's Rate of Return. Fisher's rate of return is that rate of return which equates the net present values of two different cost-benefit streams. It is estimated by equation (14). Fisher's rate of return to vocational-technical education for City A (Rate I) is 34.8 percent. Thus, at any social opportunity cost rate below this rate, the vocational-technical curriculum is preferred over the average of the curricula of the comprehensive senior high schools. The same judgment is true for City C, given the rate estimated for the vocational-technical curriculum in that city. At a social opportunity cost rate greater than the estimated rates shown in Table 43, additional investment in the curricula of the comprehensive high school would be preferred over additional investment in the curriculum of the vocational-technical senior high school. However, it is almost an impossibility that social opportunity cost rates of interest will be as high as the Fisher's rate of return shown here. The most radical suggestions never place the social opportunity cost rate of investment funds higher than that average of yields experienced on investment funds in the private sector. This rate is usually pegged somewhere near 10 percent.

Net Present Value. When criteria other than the above three are estimated, additional measurement problems arise due to the limitations stemming from the use of dummy variables for the curriculum variable when benefits are estimated. Technically, as indicated above, the partial regression coefficients of the elements of the curriculum variable set shown in Table 42 represent the differences between the average performance among the regressors of the curriculum variable. However, it can be assumed that if a graduate is shifted from the curriculum of the comprehensive high school to the vocational-technical curriculum, the resulting difference between the labor market performance of the two groups is a purely marginal change. This difference is marginal with respect to differential performance between the two curricula, not within any particular curriculum.[3] Given this assumption, net present values can be estimated using equation (8).[4] For City A these are \$264 and \$19 for the 6 and 10 percent interest rates. For City C the respective net present values are \$1,923 and \$1,369[5]. Thus, for the study sample from both City A and City C, relatively more funds should have been spent on the vocational-technical curriculum than were being spent.

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[3] The most correct measure of marginal benefit is the measure of marginal benefit within a given curriculum.

Benefit-Cost Ratio. Using equation (12), for City A at a 6 percent rate of interest the ratio of discounted marginal benefits to discounted marginal costs is 1.20. At 10 percent the ratio is 1.02. For City C, the ratios at 6 and 10 percent are 2.76 and 2.35, respectively.

Thus again the cost-benefit ratio shows that even at the relatively high rate of 10 percent, investment in the vocational-technical curriculum is worthwhile in monetary terms, and more funds should be expended on vocational-technical education, if the indices of monetary cost and benefit are valid.

Finally, both the present value of net benefits and the cost-benefit ratios are underestimated since, while it appears that money benefits converge over time for the two curricula, this convergence is averaged out over the six-year period. Some of the monetary benefit, say, of the fourth time period, is distributed to the ninth time period where a much higher discount factor applies.

Internal Rate of Return. Applying equation (14) in Chapter IV, the estimated average marginal internal rate of return to the vocational-technical curriculum for the respondent sample of City A is 7.2 percent. Using equation (17) gives an internal rate of return of 73.9 percent. This overestimate occurs since use of equation (17) implies that benefits extend to infinity.

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[4] Again, this is not strictly correct for the difference between the estimated partial regression coefficients is the difference between two averages, that is, a marginal average measure of benefit. Note that in this calculation and the ones which follow, the time stream of benefits as shown in Table 1 is the same as that used to estimate the ratio of marginal benefit difference to marginal cost difference. Assumptions about the nature of estimated benefits have been changed, however.

[5] These estimates are based on the costs for the linear estimation of pooled years shown in Tables 20 and 21.

E. The Investment Return: Total (Current and Capital) Costs

For City A, information on capital costs exists. Marginal costs based on total (current and capital) costs were estimated. The relevant cost-benefit streams are shown in Table 44. The criterion measures are shown in Table 45.

Relative to the results displayed in Table 43 based on total current costs for City A, the criterion measures all decrease in size. This is obviously to be expected. For instance, at the ten percent interest rate for marginal costs by linear approximation, the ratio of difference in marginal benefits to difference in marginal costs drops from 2.6 to 2.5. Fisher's rate of return (Rate I) drops from 34.8 percent to 33.6 percent. And, the internal rate of return (Rate II) drops from 7.2 percent to 6.2 percent. However, even when capital costs are added to current costs, all the criterion measures except one (PV-II at 10%) continue to indicate that, for this sample, allocation of additional investment funds to vocational-technical education is preferred.

F. The Investment Return: Differential Job Placement Periods

The regression analysis of Chapter VIII indicates that, on the average, the graduates of vocational-technical curriculum were placed in jobs several weeks earlier than were the graduates from the comprehensive senior high school curricula. This job placement differential times the average weekly earnings of the vocational-technical graduate during this period represents an additional benefit to the graduates of the vocational-technical curriculum. Table 46 shows the estimated criterion measures for City A and C, based on total current cost. On the average, the graduates from the vocational-technical senior high schools in City A were employed about four weeks sooner than the graduates from the comprehensive senior high schools in that city. During that four-week period the vocational-technical graduates earned about $73 per week before taxes, or after appropriate rounding, $295 more than their comprehensive senior high school counterparts. In City C, the vocational-technical graduates were employed about eight weeks sooner at average weekly before-tax earnings of $72, or a total of $586. These benefit differentials are entered into the calculations at time period 4.

As would be expected, relative to the results in Table 43, the criterion measures are all higher. For City A, the internal rate of return (Rate II) estimated for linear marginal costs, increases from 7.2 percent to 11.5 percent. Fisher's rate of return increases from 34.8 percent to 44.4 percent. The ratio of difference in marginal benefits to differences in marginal costs at a 10 percent interest rate increases from 2.6 to 3.0. The differences in results for City C are similar.

TABLE 44

COST-BENEFIT STREAM DIFFERENTIALS BASED ON TOTAL (CURRENT AND CAPITAL) COST BETWEEN COMPREHENSIVE AND VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL GRADUATES, CITY A, IN DOLLARS, DISCOUNTED AT 0, 6, AND 10 PERCENT, (1955-56 = 100)

Time Period	Year	Marginal Costs at Average ADA			Marginal Costs by Linear Approximation		
		0	6	10	0	6	10
1	1957-58	-173	-163	-157	-204	-192	-185
2	1958-59	-173	-154	-143	-204	-182	-169
3	1959-60	-173	-145	-130	-204	-171	-153
4	1960-61	343	300	258	343	300	258
5	1961-62	343	286	237	343	286	237
6	1962-63	343	273	218	343	273	218
7	1963-64	343	261	201	343	261	201
8	1964-65	343	250	186	343	250	186
9	1965-66	343	241	173	343	241	173

Source: Costs--Table 20; Benefits--Tables 42 and 44.

Notes:

Marginal costs are based on data pooled for the fiscal years 1956 through 1960. Marginal cost differentials are negative in sign since they are considered to be negative benefits. Benefit differentials are positive.

TABLE 45

ESTIMATED MEASURES OF NET INVESTMENT BENEFIT BASED ON TOTAL (CURRENT AND CAPITAL) COST FOR THE VOCATIONAL-TECHNICAL VIS-A-VIS THE COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES, CITY A

Criterion Measure	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
Ratio of Difference in Marginal Benefits to Difference in Marginal Costs		
6%	3.5	3.0
10%	3.0	2.5
Net Present Value[1]		
PV-I		
6%	$1,149	$1,066
10%	$ 843	$ 766
PV-II		
6%	$ 314	$ 208
10%	$ 67	$ -32
Benefit-Cost Ratio[2]		
6%	1.2	1.2
10%	1.1	1.0
Rates of Return[1]		
Rate I	39.5%	33.6%
Rate II	8.2%	6.2%

Source: Tables 20, 21 and 41.

Notes:

[1] PV-I is based on estimated differences in marginal costs and differences in marginal benefits. PV-II is based on the marginal cost estimations in Tables 20 and 21, for vocational-technical education. Benefits are based on the assumption that the benefit differentials in Table 41 are marginal benefits.

Rate I is based on estimated differences in marginal costs and differences in marginal benefits. It is Fisher's rate of return, the rate of return which equates cost and benefit differences between two different cost-benefit streams. Thus, it is also the rate at which the net present values of the two streams are equal.

Rate II is the internal rate of return and is based on the actual marginal cost estimations in Tables 20 and 21 and the assumption that the benefit differentials in Table 41 are marginal benefits. Given these assumptions, this measure is the internal rate of return, the rate of monetary profit on investing in vocational-technical education.

[2] The benefit-cost ratio is based on the assumption that the estimated benefits represent marginal benefits.

TABLE 46

ESTIMATED MEASURES OF NET INVESTMENT BENEFIT BASED ON TOTAL CURRENT COST FOR DIFFERENTIAL JOB PLACEMENT PERIODS FOR THE VOCATIONAL-TECHNICAL VIS-A-VIS THE COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES, CITY A AND CITY C

Criterion Measure	City A		City C	
	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation	Marginal Costs at Average ADA	Marginal Costs by Linear Approximation
Ratio of Difference in Marginal Benefits to Difference in Marginal Costs				
6%	4.4	3.6	11.4	10.7
10%	3.8	3.0	9.8	9.2
Net Present Value[1]				
PV-I				
6%	$1,441	$1,342	$3,219	$3,197
10%	$1,099	$1,006	$2,540	$2,520
PV-II				
6%	$ 627	$ 521	$2,496	$2,435
10%	$ 342	$ 242	$1,868	$1,811
Benefit-Cost Ratio[2]				
6%	1.5	1.4	3.4	3.2
10%	1.3	1.2	3.0	2.8
Rates of Return[1]				
Rate I	53.6	44.4	108.8	104.3
Rate II	13.9	11.5	43.1	40.7

TABLE 46--Continued

Notes:

[1] PV-I is based on estimated differences in marginal costs and differences in marginal benefits.

PV-II is based on the marginal cost estimations in Tables 20 and 21, for vocational-technical education. Benefits are based on the assumption that the benefit differentials in Table 41 are marginal benefits. Differential job placement benefits enter in at time period 4.

Rate I is based on estimated differences in marginal costs and differences in marginal benefits. It is Fisher's rate of return, the rate of return which equates cost and benefit differences between two different cost-benefit streams. Thus, it is also the rate at which the net present values of the two streams are equal. Differential job placement benefits enter in at time period 4.

Rate II is the internal rate of return and is based on the actual marginal cost estimations in Tables 20 and 21 and the assumption that the benefit differentials in Table 41 are marginal benefits. Given these assumptions, this measure is the internal rate of return, the rate of monetary profit on investing in vocational-technical education.

[2] The benefit-cost ratio is based on the assumption that the estimated benefits represent marginal benefits. Differential job placement benefits enter in at time period 4.

G. The Investment Return: Whites and Nonwhites

By assuming that the distribution of students on the basis of race between the comprehensive and the vocational-technical senior high schools does not affect relative cost, it is possible to estimate investment returns on the basis of race. The assumption is a risky one and to the extent that the race pattern of enrollment differs between the types of senior high schools and among curricula, a bias enters into the cost estimates. The nature of this bias is unknown since the race distribution between the types of curricula is not known. However, such an assumption is somewhat less dangerous than assuming that the distribution of sexes is similar between the two types of senior high schools. This is clearly not the case and, thus, it is felt that an attempt to measure investment returns on the basis of sex is even less warranted than estimating them on the basis of race. Estimations on the basis of sex are not performed, therefore.

The estimated investment returns for whites and nonwhites in City A and C are shown in Table 47. For City A, there is no significant difference in the earnings of whites or nonwhites for the vocational-technical compared to the comprehensive senior high school curricula for the average of six years. Thus, in effect, there is no difference in investment measures between whites and nonwhites for the vocational-technical curriculum. The figures presented are, therefore, only illustrative.

For City C, however, white vocational-technical senior high school graduates earn significantly more than white comprehensive senior high school graduates. The same is true for nonwhites. However, the earnings differential for nonwhite vocational-technical graduates over their comprehensive counterparts is less than that for white vocational-technical graduates. The result is that the investment measures for whites range from two to 50 times greater than those for nonwhites, depending on the measure selected. Fisher's rate of return for whites is almost twice that for nonwhites. Net present value for whites based on differences in marginal costs (PV-II) is approximately fifty times larger than the respective measure for nonwhites in City C. This suggests that for the sample of non-college attending graduates of City C, vocational-technical education was a much better investment for whites than for nonwhites. A different sex distribution of graduates in the sample could likely change this judgment, though, as could exact knowledge of race-specific marginal costs in vocational-technical versus comprehensive senior high schools. Clearly, also, there is an interaction between racial bias and the types of skills one studies so that whites and nonwhites may concentrate in different skill areas in the vocational-technical senior high school. This possible bias has not been controlled for.

TABLE 47

ESTIMATED MEASURES OF NET INVESTMENT BENEFIT FOR WHITES AND NONWHITES BASED ON TOTAL CURRENT COST FOR THE VOCATIONAL-TECHNICAL VIS-A-VIS THE COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES, CITY A AND CITY C

Criterion Measure	City A				City C			
	Marginal Costs at Average ADA		Marginal Costs by Linear Approximation		Marginal Costs at Average ADA		Marginal Costs by Linear Approximation	
	White	Nonwhite	White	Nonwhite	White*	Nonwhite*	White*	Nonwhite*
Ratio of Difference in Marginal Benefits to Difference in Marginal Costs								
6%	2.9	7.2	2.4	5.8	8.4	4.1	7.8	3.8
10%	2.5	6.1	2.0	5.0	7.1	3.5	6.7	3.2
Net Present Value[1]								
PV-I								
6%	$ 824	$2,641	$ 725	$2,542	$2,291	$ 953	$2,269	$ 931
10%	$ 595	$2,032	$ -96	$1,939	$1,770	$ 711	$1,750	$ 691
PV-II								
6%	$ 10	$1,827	$ 502	$1,721	$1,568	$ 230	$1,507	$ 169
10%	$-162	$1,275	$-262	$1,175	$1,098	$ 39	$1,041	$ -18
Benefit-Cost Ratio[2]								
6%	1.0	2.5	0.9	2.3	2.5	1.2	2.4	1.2
10%	0.9	2.1	0.8	1.9	2.1	1.0	2.0	1.0
Rates of Return[1]								
Rate I	33.4	70.1	26.5	60.4	77.8	45.4	74.5	42.8
Rate II	3.2	27.8	1.3	25.1	28.3	7.8	26.5	6.4

Source: Table 41, and sample data.

Notes:

*Benefit differentials are significant at the .05 level of significance.

[1] PV-I is based on estimated differences in marginal costs and differences in marginal benefits.

PV-II is based on the marginal cost estimations in Tables 20 and 21 for vocational-technical education. Benefits are based on the assumption that the benefit differentials are marginal benefits.

Rate I is based on estimated differences in marginal costs and differences in marginal benefits. It is Fisher's rate of return, the rate of return which equates cost and benefit differences between two different cost-benefit streams. Thus, it is also the rate at which the net present values of the two streams are equal.

Rate II is the internal rate of return and is based on the actual marginal cost estimations in Tables 20 and 21 and the assumption that the benefit differentials are marginal benefits. Given these assumptions, this measure is the internal rate of return, the rate of monetary profit on investing in vocational-technical education.

[2] The benefit-cost ratio is based on the assumption that the estimated benefits represent marginal benefits.

H. Summary

Given that monetary measures of costs and benefits are an accepted index of total costs and benefits, for the sample of non-college attending graduates of City A and City C, investment in the vocational-technical curriculum is an economically efficient investment. In addition, the evidence suggests that given this sample of graduates, funds should be shifted from the curricula in the comprehensive senior high school toward the vocational-technical curriculum in the vocational-technical high school.

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CHAPTER X

VOCATIONAL EDUCATION AND THE DROPOUT

A. Introduction

There are demonstrated net money benefits accruing to vocational-technical graduates as compared to graduates of the other senior high school curricula included in this study. But in addition, it is asserted by some that further benefits accrue to vocational education by virtue of the fact that students who normally might have dropped out of high school had they been forced to pursue an academic program subsequently become successful graduates when offered the opportunity to pursue the vocational program. However, this argument can be turned on its ear, for one can argue that the presence of, say, the academic curriculum results in a higher graduation rate for those cerebrally oriented students who might otherwise have dropped out of high school had they been forced to pursue the vocational-technical curriculum. Clearly, there is nothing necessarily unique about the dropout saving propensities of the vocational-technical or any other curriculum. Choice among curricula to suit different personalities and talents is the relevant issue in dropout prevention.

However, if this assertion concerning the salvage effect of the vocational-technical curriculum is correct, then one way of testing this is the following. The experiences of vocational-technical graduates who would have dropped out had they been forced into the academic (or any other) program must be compared against the experiences of those students who drop out from high school by virtue of the fact that they are forced into a curriculum other than vocational-technical which is intellectually and constitutionally inhospitable to them. One must know how many potential dropouts switch to the vocational-technical curriculum, and, having switched, how many graduate. Also, in such an analysis, one should not assume that all nonvocational dropouts, had they prior knowledge that they were going to drop out, would have switched to the vocational-technical curriculum. Also, not all those potential nonvocational dropouts who switch to the vocational-technical curriculum will graduate. Some will drop out here, too. Therefore, the benefits of the vocational-technical curriculum in terms of dropout prevention must be weighted by the joint probability of a person who would otherwise be a dropout switching to the vocational-technical curriculum and, then, having switched, graduating. Clearly, this probability will be less than unity. Next, the number of those who drop out from the vocational-technical curriculum because some other curriculum would have been more hospitable to them must be subtracted from the gross dropout salvage effect to arrive at a net dropout prevention effect for the vocational-technical curriculum. Finally, the same analysis must be performed for all other curricula in order to determine, for a given student body, which curriculum has the greatest net dropout salvage effect.

The required information to make such an analysis is not directly available. In this study comparisons can only be made for students of any curriculum who graduate and students of any curriculum who drop out. This is ex post data when what is needed is ex ante data on who will be a likely dropout and what his preferred curriculum would be. Here, economic experiences of the dropouts from any nonvocational curriculum can be contrasted with economic experiences of vocational-technical students who drop out. The nonvocational dropouts can also be compared with nonvocational graduates. And, vocational-technical dropouts can be compared with vocational-technical graduates. A comparison of the nonvocational dropout against the vocational-technical graduate would overstate the alleged dropout prevention benefits of the vocational-technical curriculum considerably. First, not all of the vocational graduates would have dropped out had they been forced into another curriculum. Second, as mentioned above not all of the nonvocational dropouts would have graduated had they entered the vocational-technical curriculum.[1]

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[1] There is some evidence that the vocational-technical curriculum is not necessarily a salvage ground for academic curriculum misfits. Efforts are constantly made in all three cities investigated to upgrade the quality of the entrants into the vocational-technical curriculum so that they are not much different from the academic entrant in terms of quality. Of course, the vocational-academic curriculum can be more rigorous and demanding than either the academic or the vocational-technical curriculum taken alone. Finally, in at least one city of the three studied, several counselors indicated that the typical dropout was quite likely a student transferred from the vocational-technical curriculum or the academic curriculum into the general curriculum. A person who is a potential academic dropout in a comprehensive high school is

(Continued)

Comparison of vocational-technical dropouts against nonvocational dropouts will give biased results since it may be the case that some of both the vocational-technical and the nonvocational dropouts might have graduated had they pursued a different curriculum. Also an undetermined number of students will likely drop out regardless of the curriculum they pursue. Unless this latter group is distributed proportionately across the various curricula, a bias will enter into any analysis. Such a proportional distribution is not too likely. Finally, and most important, this comparison will only indicate that, other things equal, if one is going to drop out, it will be relatively better to drop out of one curriculum rather than another.

B. The Dropout Sample

The dropouts in the following analysis were all either juniors or seniors at the time they dropped out. Also, they were members of the same cohorts as those students in the sample who did graduate. The employment and earnings benefits of the dropouts were measured from the time when they would have graduated had they not dropped out. Thus, while their earnings and employment experience parallels in time that of the graduates, there is an upward bias in the dropout earnings due to the fact that the dropouts have an undetermined amount of on-the-job training which should raise their earnings relative to those of recent high school graduates. The useable sample of dropouts is small and its representativeness of the dropout population for the study cohort is open to question as will be shown below.

Tables 48, 49, and 50 describe the socio-demographic characteristics of the dropout sample. As Table 48 shows, white dropouts have higher average IQs than nonwhite dropouts, regardless of sex. Also, as might be expected the average number of years of father's education is higher for white dropouts than for nonwhite dropouts, regardless of sex.

With respect to earnings and employment Table 49 indicates that males and whites generally earn more and are employed more than females and nonwhites, as one would expect. However, low IQ dropouts

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1. (Continued) not likely to be welcomed into the vocational-technical curriculum. If he is and it appears that he will drop out anyway, he will often transfer back into the general curriculum of a comprehensive high school, and possibly become a dropout from that point. None of the statistics on dropouts which are currently collected by the school districts of the three cities will permit any test of the hypotheses put forward in this chapter.

TABLE 48

SEX AS A FUNCTION OF RACE AND FATHER'S EDUCATION, AND RACE AND IQ, FOR DROPOUTS, CITIES A, B, AND C

Sex	Father's Education		IQ	
	White	Nonwhite	White	Nonwhite
Male	9.1[a] (3.5) 32	8.6 (3.9) 11	102.5[b] (12.1)	96.2 (10.5)
Female	9.4 (2.8) 40	8.2 (3.6) 18	103.4 (11.9)	96.8 (7.7)
Average	9.3 (3.1) 72	8.3 (3.6) 29	103.0 (11.9)	96.6 (8.7)

[a] In descending order, the statistics are the cell mean, the standard deviation of the cell mean, and the number of observations per cell.

[b] The number of observations per cell are the same as for Father's Education.

TABLE 49

THE RELATIONSHIP BETWEEN SELECTED SOCIO-DEMOGRAPHIC VARIABLES AND THE PERCENT OF TIME EMPLOYED AND AVERAGE MONTHLY BEFORE TAX EARNINGS IN DOLLARS DURING THE PROJECTED POST-GRADUATION PERIOD FOR DROPOUTS[a]

Variable	% of Time Employed: Six Year Average	% of Time Employed: First Year	% of Time Employed: Sixth Year	Average Monthly Before-Tax Earnings: Six Year Average	Average Monthly Before-Tax Earnings: First Year	Average Monthly Before-Tax Earnings: Sixth Year
Sex						
Male 43[b]	90.4[c] (16.6)	88.8 (27.1)	95.0 (18.5)	410.4 (169.5)	341.9 (197.2)	480.1 (193.9)
Female 58	43.8 (33.8)	45.7 (45.3)	46.0 (44.8)	133.5 (121.4)	126.1 (140.8)	148.6 (165.0)
Race						
White 72	64.0 (35.6)	69.2 (41.5)	67.2 (43.3)	263.5 (205.4)	240.6 (202.1)	299.4 (257.0)
Nonwhite 29	62.7 (38.0)	51.1 (48.0)	65.8 (44.2)	221.4 (180.3)	161.83 (177.8)	265.6 (201.0)
IQ						
Low: 89 or Less 15	72.2 (39.8)	78.9 (32.2)	75.6 (42.7)	294.6 (203.9)	300.8 (191.9)	325.1 (215.2)
Average: 90-110 67	62.4 (36.1)	61.4 (45.3)	62.6 (44.6)	232.5 (187.1)	194.2 (183.8)	270.6 (243.4)
High: 111 or More 19	61.2 (33.8)	61.5 (46.9)	75.0 (39.2)	283.8 (232.8)	236.5 (238.2)	329.0 (259.6)
City						
A 33	69.2 (35.9)	76.3 (37.5)	62.4 (43.7)	284.2 (222.9)	276.0 (212.0)	292.7 (256.5)
B 54	61.8 (36.7)	56.3 (46.5)	68.5 (44.3)	234.7 (186.4)	177.6 (180.4)	276.3 (233.7)
C 14	57.5 (34.7)	65.1 (44.6)	70.8 (40.9)	238.6 (187.6)	237.2 (204.7)	334.3 (249.0)

[a] The year is estimated from the point of time at which the dropout would have graduated had he continued in school.

[b] The numbers below each socio-demographic characteristic are the sample sizes of the characteristic in question.

[c] In descending order, the statistics are the cell mean and the standard deviation of the cell mean.

TABLE 50

THE RELATIONSHIP BETWEEN SECONDARY CURRICULA AND PERCENT OF TIME EMPLOYED DURING THE PROJECTED SIX-YEAR POST-GRADUATION PERIOD FOR DROPOUTS, BY SEX

Curriculum	% of Time Employed Over the Six-Year Post-Graduation Period[a]			% of Time Employed in the First Year after Graduation			% of Time Employed in the Sixth Year after Graduation		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Vocational-Academic	92.6[b] (12.8) 3	57.0 (60.9) 2	78.3 (37.3) 5	100.0[c] (0.0)	91.6 (11.8)	96.7 (7.5)	66.7 (57.7)	50.0 (70.7)	60.0 (54.8)
Vocational-Comprehensive	100.0 (0.0) 1	47.8 (31.2) 18	50.5 (32.6) 19	100.0 (0.0)	47.7 (47.5)	50.4 (47.7)	100.0 (0.0)	50.9 (42.5)	53.5 (42.8)
General	88.5 (16.0) 9	21.5 (6.8) 2	76.4 (30.7) 11	90.7 (18.8)	37.5 (53.0)	81.1 (32.1)	98.1 (5.6)	0.0 (0.0)	80.3 (40.0)
Vocational-Technical	94.8 (9.4) 21	48.5 (37.6) 23	70.6 (36.2) 44	95.2 (10.4)	54.4 (44.3)	73.9 (38.5)	96.4 (14.6)	50.7 (48.3)	72.5 (42.7)
Academic	79.9 (27.0) 9	31.2 (27.8) 13	51.1 (36.4) 22	66.7 (50.0)	22.0 (39.9)	40.3 (48.7)	97.2 (8.3)	37.2 (41.9)	61.7 (44.1)
Total	90.4 (16.6) 43	43.8 (33.8) 58	63.6 (36.1) 101	88.8 (27.1)	45.7 (45.3)	64.0 (44.0)	95.0 (18.5)	46.0 (44.8)	66.8 (43.3)

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[a] The year is estimated from the point of time at which the dropout would have graduated had he continued in school.

[b] These statistics are, in descending order, the cell mean, the standard deviation of the cell mean, and the number of observations in the cell.

[c] Number of observations is not repeated since these are constant for all the subsequent indices displayed in this table.

earn more and are employed more on the average over the projected six-year post-graduation period than are high IQ dropouts. The number of observations is smaller, however.

Table 50 indicates that male and female vocational-technical and vocational-academic dropouts are employed more on the average over the projected six-year post-graduation period than are their academic counterparts. However, in the projected sixth year after graduation male academic dropouts are employed more on the average than their vocational-technical counterparts. However, all these results are gross effects, and multiple regression analysis is needed to estimate the net effects on employment and earnings of such variables as curriculum and sex among the dropout sample.

C. Comparison of Academic and Vocational-Technical Dropouts

Given that a student drops out of high school, which curriculum pursued creates the least labor market disability, other things equal? An inspection of Tables 51, 52, and 53 provides some insight into this question.

Employment. As with the high school graduates, the vocational-technical dropouts fare better over the first year after the projected graduation date than do the academic dropouts. On the average, vocational-technical graduates are employed 27.8 percentage points, or over three months, more (27.8 x 12 = 3.34) than are academic dropouts. The difference is statistically significant at the .01 level of significance. Vocational-technical dropouts are employed only 9.6 percentage points (1.2 months) more than academic dropouts on the average during the sixth year after the projected graduation date, but as with the graduate sample, this difference is not statistically significant, so that there are no differences in the experience of dropouts from the two curricula in the sixth year after the projected graduation date. Finally, on the average over the six-year period, vocational-technical dropouts are employed 16.1 percentage points (11.6 months) more than are academic dropouts. This difference is statistically significant at the .05 level of significance. The curriculum variable is not statistically significant for any of these three cases. This is partly due to the difficulty of identifying the curriculum of the dropout. This difficulty is especially marked with respect to all curricula except the vocational-technical.[2]

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[2] However, regression equations which, in effect, pool all curricula result in larger standard errors of estimate for the equations as a whole and the t-ratios are considerably smaller for the pooled elements of the curriculum variable. Thus, it is better to keep curriculum broken into five regressors rather than two, vocational-technical and all else.

TABLE 51

EMPLOYMENT EXPERIENCE OF SENIOR HIGH SCHOOL DROPOUTS FOR SELECTED TIME PERIODS AFTER THE PROJECTED GRADUATION DATE, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year after Projected Graduation		Sixth Year after Projected Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	19.0	(14.8)	37.8	(20.1)	2.0	(19.8)
Vocational-Comprehensive	17.8	(9.5)	21.6	(13.0)	19.6	(12.8)
General	10.1	(11.4)	19.4	(15.5)	1.4	(15.3)
Vocational-Technical	16.1*	(7.4)	27.8**	(10.1)	9.6	(10.0)
Labor Market						
City A@						
City B	2.6	(6.9)	-9.0	(9.4)	17.8	(9.3)
City C	-9.8	(9.3)	-10.6	(12.7)	10.6	(12.6)
Male	47.0**	(6.4)	38.1**	(8.7)	54.5**	(8.6)
IQ	-.07	(.27)	-.24		.10	(.36)
White	1.8	(6.8)	16.1	(9.3)	2.8	(9.2)
Marital Status						
Married@						
Single	11.5	(7.0)	11.7	(9.5)	12.0	(9.4)
Separated, Widowed, Divorced	-39.6	(28.8)	-38.9	(39.3)	-16.3	(38.7)
Father's Education	-.52	(.86)	-.50	(1.17)	.38	(1.15)
Number of Observations	101		101		101	
Coefficient of Determination#	.44		.29		.29	
Intercept	39.1	(29.4)	48.7	(40.1)	6.3	(39.5)
Standard Error of Estimate	27.0		37.0		36.4	
Mean of Dependent Variable	63.6	(36.1)	64.0	(44.0)	66.8	(43.3)
F-Ratio:						
All Variables	7.40**		4.45**		4.44**	
Curriculum	1.43		2.11		.72	
Labor Market	.93		.57		1.84	
Marital Status	2.55*		1.37		.97	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE 52

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF SENIOR HIGH SCHOOL DROPOUTS FOR SELECTED TIME PERIODS AFTER THE PROJECTED GRADUATION DATE, IN DOLLARS

Variable	Average in Six Years		First Year after Projected Graduation		Sixth Year after Projected Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	60	(78)	45	(88)	11	(100)
Vocational-Comprehensive	56	(50)	36	(57)	45	(64)
General	14	(60)	22	(68)	-18	(77)
Vocational-Technical	88*	(39)	106*	(44)	48	(50)
Labor Market						
City A[@]						
City B	4	(36)	-67	(41)	61	(46)
City C	-53	(49)	-45	(56)	43	(63)
Male	286**	(34)	197**	(38)	356**	(43)
IQ	.50	(1.43)	-.91	(1.62)	-.05	(1.83)
White	19	(36)	54	(41)	28	(46)
Marital Status						
Married[@]						
Single	-28	(37)	-19	(42)	-11	(47)
Separated, Widowed, Divorced	-114	(152)	-100	(172)	270	(194)
Father's Education	-3	(4)	-6	(5)	.4	(6)
Number of Observations	101		101		101	
Coefficient of Determination[#]	.47		.32		.44	
Intercept	54	(155)	232	(176)	53	(198)
Standard Error of Estimate	143		162		183	
Mean of Dependent Variable	251	(198)	218	(198)	290	(242)
F-Ratio:						
All Variables	8.64**		5.06**		7.22**	
Curriculum	1.54		1.77		.43	
Labor Market	.75		1.33		.87	
Marital Status	.53		.25		1.04	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE 53

AVERAGE BEFORE TAX HOURLY EARNINGS OF HIGH SCHOOL DROPOUTS FOR SELECTED TIME PERIODS AFTER THE PROJECTED GRADUATION DATE, IN DOLLARS

Variable	Average in Six Years		First Year after Projected Graduation		Sixth Year after Projected Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	.02	(.38)	-.003	(.48)	-.13	(.61)
Vocational-Comprehensive	.27	(.24)	.12	(.31)	.29	(.40)
General	-.09	(.29)	.18	(.37)	-.38	(.47)
Vocational-Technical	.24	(.19)	.60*	(.24)	.10	(.31)
Labor Market						
City A@						
City B	.07	(.18)	-.42	(.22)	.23	(.29)
City C	.01	(.24)	-.26	(.30)	.02	(.39)
Male	.92**	(.16)	.84**	(.21)	1.69**	(.27)
IQ	.002	(.007)	.009	(.009)	.008	(.01)
White	.28	(.17)	.56*	(.22)	.23	(.28)
Marital Status						
Married@						
Single	-.31	(.18)	.13	(.22)	-.15	(.29)
Separated, Widowed, Divorced	-.64	(.73)	.27	(.93)	.47	(1.20)
Father's Education	.01	(.02)	-.02	(.03)	.01	(.04)
Number of Observations	101		101		101	
Coefficient of Determination#	.26		.29		.25	
Intercept	.95	(.75)	1.56	(.95)	-.22	(1.22)
Standard Error of Estimate	.69		.87		1.13	
Mean of Dependent Variable	1.96	(.81)	1.31	(1.04)	1.77	(1.32)
F-Ratio:						
All Variables	4.10**		4.54**		4.00**	
Curriculum	.83		2.11		.49	
Labor Market	.10		1.78		.36	
Marital Status	1.78		.19		.24	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

With respect to the other variables in the employment equations, none is statistically significant except sex. Males consistently earn more than females, even after the effects of marital status are held constant. Surprisingly enough, the effect of race is not statistically significant for the study sample. Thus, there is no difference in the employment experience of whites and nonwhites for this sample. There is no difference in employment experience between cities, either.

Social Earnings Benefits. The pattern of statistical significance for social earnings benefits is similar to the pattern of statistical significance for employment. By the sixth year after the projected graduation date there is no statistical difference between academic dropouts and vocational-technical dropouts. But in the first year after the projected graduation date, vocational-technical dropouts earn an average of $106 more per month than do academic dropouts. This amounts to $1,272 for the entire year, a considerable sum. The difference is statistically significant at the .05 level of significance. In contrast, there is no statistically significant difference between the earnings of the academic dropout and dropouts from the remaining three curricula--vocational-academic, vocational-comprehensive or general--for any of the three time periods measured. Of the remaining independent variables, none are statistically significant except sex. Males consistently earn more than females. A $200 monthly earnings differential in favor of males for the first year after the projected graduation date widens to about $350 per month on the average during the sixth year after the projected graduation date. This earnings differential exists even after controlling for marital status, though controlling for marital status is an imperfect control for family life cycle, a variable more relevant to female labor force participation. In short, for dropouts, the variables affecting labor market success are the dropout's sex and his curriculum. And, after six years have passed, for the variables included in the model, only sex is of statistical significance for the study sample.

D. Comparison of Comprehensive Senior High School Graduates and Dropouts

As Tables 54 and 55 show, the study data verify the fact that it pays to graduate from high school rather than to drop out. In the first year after graduation, students from comprehensive high schools were employed 21.5 percentage points (2.6 months) more than were dropouts. In addition, during this first year the graduates earned an average of $51 more per month than did the dropouts. However, it is again the case that by the sixth year, there is no statistically significant difference in employment or earnings between the graduates and the dropouts of the comprehensive senior high schools. This is a finding contrary to one's expectations, even though the difference in

TABLE 54

EMPLOYMENT EXPERIENCE OF COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES AND DROPOUTS FOR SELECTED TIME PERIODS AFTER THE ACTUAL OR PROJECTED GRADUATION DATE, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year after Actual or Projected Graduation		Sixth Year after Actual or Projected Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	12.1**	(4.0)	13.8**	(5.0)	10.7	(6.2)
Vocational-Comprehensive	5.5	(2.3)	13.1**	(2.9)	4.8	(3.6)
General	3.4	(2.8)	7.6*	(3.5)	1.7	(4.3)
Labor Market						
City A@						
City B	-3.3	(2.4)	-4.0	(2.9)	.4	(3.6)
City C	-6.6	(2.7)	-9.4**	(3.4)	1.1	(4.2)
Male	22.7**	(2.2)	6.4*	(2.7)	44.6**	(3.4)
IQ	.16*	(.08)	.06	(.10)	.33**	(.12)
White	9.4**	(2.8)	25.1**	(3.5)	-7.7	(4.4)
Marital Status						
Married@						
Single	14.8**	(2.3)	.0	(2.8)	33.7**	(3.5)
Separated, Widowed, Divorced†	-11.7	(8.4)	-32.7**	(10.4)	.1	(12.9)
Father's Education	-.71*	(.30)	-.91*	(.38)	-.57	(.47)
Graduate	20.7**	(4.9)	21.5**	(6.1)	14.6	(7.6)
Number of Observations	747		747		747	
Coefficient of Determination#	.22		.15		.29	
Intercept	26.0	(9.8)	30.2	(12.2)	4.4	(15.1)
Standard Error of Estimate	24.8		30.8		38.2	
Mean of Dependent Variable	74.9	(28.2)	76.3	(33.2)	63.6	(45.4)
F-Ratio:						
All Variables	18.94**		11.01**		26.62**	
Curriculum	3.93**		7.82**		1.35	
Labor Market	3.22*		3.99*		.03	
Marital Status	22.21**		4.94**		45.33**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.
† There are nine observations in this element of the set.

TABLE 55

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF COMPREHENSIVE SENIOR HIGH SCHOOL GRADUATES AND DROPOUTS FOR SELECTED TIME PERIODS AFTER THE ACTUAL OR PROJECTED GRADUATION DATE, IN DOLLARS

Variable	Average in Six Years		First Year after Actual or Projected Graduation		Sixth Year after Actual or Projected Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	66**	(22)	68**	(21)	52	(30)
Vocational-Comprehensive	35**	(18)	54**	(12)	26	(17)
General	18	(15)	32*	(15)	16	(21)
Labor Market						
City A[@]						
City B	-2	(13)	-2	(12)	1	(18)
City C	-8	(15)	-42**	(14)	40	(21)
Male	200**	(12)	88**	(11)	326**	(16)
IQ	1.42**	(.42)	.79	(.41)	2.19**	(.59)
White	75**	(15)	113**	(15)	17	(21)
Marital Status						
Married[@]						
Single	42**	(12)	-8	(12)	113**	(17)
Separated, Widowed, Divorced†	-36	(45)	-74	(44)	14	(63)
Father's Education	-22	(1.6)	-2.3	(1.6)	-3.6	(2.3)
Graduate	91**	(26)	51*	(26)	68	(37)
Number of Observations	747		747		747	
Coefficient of Determination#	.35		.20		.40	
Intercept	-79	(52)	-11	(52)	-130	(74)
Standard Error of Estimate	133		131		187	
Mean of Dependent Variable	285	(165)	243	(145)	281	(243)
F-Ratio:						
All Variables	34.45**		15.10**		43.36**	
Curriculum	4.66**		8.10		1.38	
Labor Market	6.35**		4.59**		2.04	
Marital Status	.13		1.58		21.34**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.
†	There are nine observations in this element of the set.

experience between dropouts and graduates is statistically significant for the average of six years. Apart from the possibility of bias due to the sample structure, this finding could again lie in the fact that factors other than failure to graduate from high school become increasingly more important as determinants for employment success as time passes. Also, these factors, such as IQ, motivation, or other characteristics are not correlated with high school performance in such a way that they act to compound the disadvantages of a lack of high school graduation. The effect of IQ, for instance, is not statistically significant in the first year after the actual or projected graduation date, but it is highly significant statistically in the sixth year after the actual or projected graduation date. Both curriculum and labor market are statistically significant in the first year after the actual or projected graduation date, but are not statistically significant in the sixth year after the actual or projected graduation date. Finally, one of the major factors which could account for the difference between the first and sixth years may lie in the sex composition of the sample. As indicated below, a large proportion of the study sample is female.

As time passes, female graduates and dropouts tend to get married and subsequently leave the labor force. If the type of curriculum and graduate-dropout status are distributed uniformly between the two sexes, then, with the passage of time and subsequent marriage of the females, sex will become a more dominant determinant of labor market success than will curriculum or completion of high school.

E. Comparison of Vocational-Technical Graduates and Dropouts

The size, sign and pattern of statistical significance of the variables in the equations for vocational-technical graduates and dropouts are similar to those for the variables in the equations for the comprehensive graduates and dropouts. (See Tables 56 and 57.) However, for both employment and earnings there is no statistical significance between vocational-technical graduates and dropouts for the first and sixth years after the actual or projected graduation date even though there is a statistically significant difference in employment and earnings between vocational-technical dropouts and graduates for the average of six years. For the average of six years graduates earn $56 more per month and are employed 14.2 percentage points (1.7 months) more per year than are dropouts.

In contrast, comprehensive graduates are employed 20.7 percentage points (2.3 months) more per year on the average over the six-year period than are comprehensive dropouts. Comprehensive graduates earn $91 more per month than comprehensive dropouts over the six-year period. Thus the absolute differences between comprehensive graduates and dropouts are greater than the absolute differences between

TABLE 56

EMPLOYMENT EXPERIENCE OF VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL GRADUATES AND DROPOUTS FOR SELECTED TIME PERIODS AFTER THE ACTUAL OR PROJECTED GRADUATION DATE, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year after Actual or Projected Graduation		Sixth Year after Actual or Projected Graduation	
	b	(s)	b	(s)	b	(s)
Labor Market						
City A@						
City B	-2.9	(2.4)	-4.1	(2.8)	1.0	(3.8)
City C	-5.0	(2.4)	-13.4**	(2.8)	1.3	(3.8)
Male	19.4**	(2.2)	3.5	(2.6)	36.2**	(3.6)
IQ	.02	(.09)	.19	(.11)	-.13	(.16)
White	2.8	(2.9)	17.6**	(3.3)	-10.1*	(4.6)
Marital Status						
Married@						
Single	16.5**	(2.3)	-3.4	(2.7)	32.7**	(3.6)
Separated, Widowed, Divorced†	26.8	(16.9)	7.3	(19.6)	46.7	(26.7)
Father's Education	.60	(.35)	.03	(.41)	.94	(.56)
Graduate	14.2**	(4.4)	9.2	(5.1)	6.5	(7.0)
Number of Observations	609		609		609	
Coefficient of Determination#	.19		.10		.24	
Intercept	48.6	(11.1)	43.8	(12.8)	61.2	(17.5)
Standard Error of Estimate	23.8		27.6		37.5	
Mean of Dependent Variable	79.1	(26.4)	82.6	(28.9)	71.2	(43.2)
F-Ratio:						
All Variables	16.54**		7.39**		22.75**	
Labor Market	2.25		11.73**		.07	
Marital Status	26.34		.90		41.08**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.
†	There are two observations for this element of the set.

TABLE 57

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF VOCATIONAL-TECHNICAL HIGH SCHOOL GRADUATES AND DROPOUTS FOR SELECTED TIME PERIODS AFTER THE ACTUAL OR PROJECTED GRADUATION DATE, IN DOLLARS

Variable	Average in Six Years		First Year after Actual or Projected Graduation		Sixth Year after Actual or Projected Graduation	
	b	(s)	b	(s)	b	(s)
Labor Market						
City A[@]						
City B	-13	(14)	-19	(14)	-6	(19)
City C	-9	(14)	-27	(14)	44	(19)
Male	206**	(13)	96**	(13)	322**	(18)
IQ	1.15	(.59)	1.16*	(58)	.65	(.78)
White	44*	(17)	89**	(17)	-9	(23)
Marital Status						
Married[@]						
Single	51**	(14)	-9	(14)	114**	(18)
Separated, Widowed, Divorced[†]	128	(101)	59	(99)	230	(132)
Father's Education	3.1	(2.1)	1.6	(2.1)	5.8*	(2.8)
Graduate	56*	(26)	34	(26)	56	(38)
Number of Observations	609		609		609	
Coefficient of Determination[#]	.29		.13		.38	
Intercept	8	(66)	19	(65)	34	(87)
Standard Error of Estimate	143		139		187	
Mean of Dependent Variable	309	(170)	269	(149)	318	(237)
F-Ratio:						
All Variables	29.15**		11.26**		41.68**	
Labor Market	1.01		1.98		3.75	
Marital Status	7.40**		.41		20.59**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.
† There are nine observations in this element of the set.

vocational-technical graduates and dropouts. A variety of reasons could lie behind this observed difference. First, if other things are equal, this may imply that if one is going to drop out, he should drop out from the vocational-technical curriculum rather than a nonvocational-technical curriculum since he will suffer less in terms of reduced earnings and employment relative to the graduate. Thus, while we can say nothing about the dropout saving propensities of the vocational-technical curriculum, we may be able to assert that dropouts from this curriculum fare less badly than dropouts from other curricula.

But other things are not equal. The sets of graduates and dropouts may acquire different amounts of on-the-job training which accounts for the observed differences, though if this is a function of curriculum, it may still argue in terms of a more favorable case for the vocational-technical curriculum. It might also be the case that vocational-technical dropouts tend to have more education when they leave school than do the comprehensive dropouts. That is, the former may be dropping out in their senior year while the latter drop out in their junior year.

Next, the two groups may be dropping out for different reasons. Vocational-technical dropouts may be dropping out in response to perceived labor market opportunities and not because of any fundamental inability to successfully complete a high school curriculum. That is, economic pressure may be a factor explaining dropping out from the vocational-technical school and not scholastic failure. However, scholastic failure may be the case with respect to those who drop out from the comprehensive high school. They may be more likely to fall among the group of scholastic misfits. Thus, given different socio-demographic backgrounds and different types of schools, dropouts occur in both types of schools but possibly for entirely different reasons. Indeed, if the tendency to scholastic failure were the same between the two types of schools but economic pressures were quite different, one might even observe higher dropout rates among vocational-technical students since their very curriculum would be conducive to taking advantage of perceived immediate labor market opportunity. So, in short, differential dropout rates between types of schools may not be related to the curriculum of the schools at all, but may be a function of the specific nature of the populations of the two types of schools. And, one might even view a perceived higher dropout rate for vocational-technical schools as a measure of its success in training students in skills related to labor market needs. Finally, this whole argument may be aggravated by the fact that the level of school attendance and employment opportunities tend to be inversely related.

F. Comparability of Graduate and Dropout Samples

This analysis must be qualified by one further finding. The graduate and the dropout samples were drawn differently. Also, access to the total population of dropouts was not possible in City A since complete records were not available. Finally, the samples may be from different populations, regardless of the way in which they were drawn. This latter hypothesis was tested according to the technique outlined in Appendix IV. It turns out that in comparing the employment and earnings experience of the graduates and dropouts, the F-statistics for the relevant test are 5.97 and 3.39, respectively. Thus, the conclusion is that the two samples are drawn from different populations and, therefore, are not strictly comparable.

G. Dropout Experience Prior to Projected Graduation

An effort was made to estimate earnings differentials among curricula for the dropouts during that period from the time of dropping out to the projected time of graduation. These results are summarized for different equations in Table 58. Only the partial regression coefficients of the curriculum variable are presented. Other variables enter each equation. These are race, IQ, marital status, father's education, city, and number of months between time of dropping out of school and time of projected graduation. For brevity, these partial regression coefficients are not presented. The sample size and composition is different here compared to the above analysis, due to differing data availability and analytical need.

The hypothesis being tested here is as follows: Do vocational-technical dropouts earn more money immediately upon dropping out compared to dropouts from the comprehensive high school? If they do, these earnings differences can be a crude index to the costs incurred by the vocational-technical graduate in continuing his senior high school education vis-a-vis the graduates from the comprehensive senior high school. The cost estimates in Chapter IX should then be revised upward when vocational-technical education is evaluated as an investment, although one must acknowledge that the earnings of dropouts during what would have been their 11th and 12th years of senior high school are only a rough approximation of the earnings graduates would receive were they working during these years.[3]

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[3] Employment histories during school attendance were not collected in this study to estimate such opportunity costs directly. Any future cost-benefit analysis of vocational-technical education should correct for this shortcoming.

TABLE 58

BEFORE TAX EARNINGS DIFFERENTIALS AMONG VOCATIONAL-TECHNICAL AND COMPREHENSIVE SENIOR HIGH SCHOOL DROPOUTS FROM THE TIME OF DROPPING OUT TO THE TIME OF INTENDED GRADUATION, IN DOLLARS

Curriculum[a]	b (s)	I (s)	N	SEE	F	$\bar{R}^2$
Equation (1)		-17 (105)	238	146	3.04*	.39**
Vocational-Academic	112* (55)					
Vocational-Comprehensive	91** (32)					
General	131** (29)					
Vocational-Technical	77** (29)					
Equation (2)		164 (91)	238	149	.23	.36**
Vocational-Academic	26 (49)					
Vocational-Technical	10 (21)					
Equation (3): City A		560 (175)	64	134	.24	.50**
Vocational-Academic	-5 (52)					
Vocational-Technical	-29 (42)					
Equation (4): City B		76 (137)	123	140	2.52	.35**
Vocational-Technical[b]	44 (28)					
Equation (5): City C		94 (220)	51	171	.32	.35**
Vocational-Academic	80 (132)					
Vocational-Technical	-27 (58)					

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
N	is the number of observations.
I	is the constant term.
SEE	is the standard error of the estimate.
F	is the F-statistic for the curriculum variable.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

[a] In addition to curriculum, equation (1) contains the following independent variables: City--City A, B and C; Race--white and nonwhite; Sex--male and female; IQ; Father's Education; Marital Status--married, single, separated, widowed, or divorced; and number of months between time of dropping out and time of intended graduation.

Equations (2), (3), (4) and (5) contain the following additional independent variables: City, Race, Sex, IQ, Father's Education, Marital Status, and number of months between time of dropping out and time of intended graduation.

[b] There is no vocational-academic curriculum for City B.

However, while vocational-technical dropouts earn significantly more than academic dropouts during the time from dropping out to projected graduation date [Equation (1)], dropouts from the vocational-technical senior high school do not earn significantly more than dropouts from the comprehensive senior high schools [Equation (2)]. The cost data in Chapter VII is estimated for vocational-technical and comprehensive senior high schools. Thus, opportunity costs must be estimated on the same basis for inclusion in Chapter IX. In effect, there is no statistical difference in foregone earnings between the dropouts of the two types of senior high schools. The difference is zero, then, and additional opportunity costs cannot be imputed among the graduates of the two types of senior high schools, given the data for the study sample.

H. Summary

Vocational-technical dropouts in the study sample fare better than dropouts from the other four curricula. Vocational-technical dropouts do not fare as badly vis-a-vis their graduate counterparts as do dropouts from comprehensive senior high schools. The reasons for this are unclear, but are undoubtedly related to the fact that the vocational-technical curriculum is consciously geared to immediate employment opportunity in specific skill areas whereas the curricula offered in the comprehensive high school either are not necessarily geared to immediate employment, or, if graduation terminates formal education, are not geared so closely to specific skills. However, all these results are questionable to some degree since the graduate and the dropout samples do not come from the same population.

CHAPTER XI

ANALYSIS OF NON-MONETARY AND NON-ECONOMIC BENEFITS AND PERFORMANCE

A. Introduction

The purpose of this chapter is to bring together an analysis of certain non-monetary and non-economic benefits and performance characteristics which are potentially related to the curriculum of the vocational-technical and nonvocational-technical graduates. Topics treated in this chapter deal with voting behavior, the job-career relationship, and the economic aspirations of the graduates. While an investigation of these aspects does not circumscribe the entire range of non-monetary and non-economic dimensions of secondary vocational-technical and nonvocational-technical education, such an investigation should serve as an index to these dimensions. In all of the analyses to follow, those independent variables were used which proved to have the strongest explanatory power for the analysis of economic benefits as presented in Chapter VIII. Other independent variables such as military service and actual earnings were tried in different models, but these had no appreciable advantage over the simpler formulations finally employed.

B. Voting Behavior

Questions were asked to determine whether or not a person was eligible to vote and, if so, whether or not he had voted in the 1964 Presidential election and the 1966 primary elections. (See Appendix I.) As Table 55 shows, the curriculum variable was not statistically significant for either dependent variable. Thus, it cannot be said for the study sample that curriculum, among the independent variables, has any statistically significant effect on voting behavior.

Next, there was no statistically significant difference in voting behavior between the four curricula compared to the academic curriculum for voting in the 1966 primary elections. However, the graduates of the vocational-technical curriculum voted 8.1 percent less in the 1964 Presidential election than did the academic graduates. As can be seen from Table 59, this difference is net of the effect of labor market, sex, IQ, race, marital status, father's education and the average percent of time a person was employed in the six-year period after graduation. This net difference is significant at the .05 level of statistical significance.

The graduates of City B were less likely to vote in either election than were the graduates in City A. The differences are statistically significant at the .05 level. But there is no statistically significant difference in the voting behavior of graduates in City A and City C. The labor market variable is statistically significant at the .05 level.

Next, while the marital status variable is not statistically significant for the 1966 primaries, it is for the 1964 Presidential election. Those who were separated, widowed or divorced voted 17.9 percent less than those graduates who were married at the time the interviews were conducted.

Next, for each percentage point increase in employment over the six-year period, the likelihood that a graduate would vote in the 1964 Presidential election increased by .13 of one percent. The relation is statistically significant at the .05 level of significance. None of the other variables in either of the models measures statistically significant net effects.

In summary, for this sample of 674 high school graduates, if voting behavior is a measure of citizenship and social participation, curriculum does not have any statistically significant impact on socialization.

Interaction Effects. One possible reason for the lack of statistical significance shown above could be the fact that aggregation of the data obscures important interrelationships among the variables. Another reason could lie in the possible multicollinearity among the independent variables. Tables 60 and 61 show separate equations estimated for sample sub-groups. These separate equations should help reveal relationships that are possibly obscured in the equation for the aggregate sample of 674.

Table 60 relates to voting behavior in the 1966 primary elections. Only one of the 12 interaction equations shown is statistically significant, that equation for graduates having IQs of 90-110. The curriculum variable is not significant for any sub-group.

TABLE 59

VOTING BEHAVIOR OF HIGH SCHOOL GRADUATES, 1964 PRESIDENTIAL ELECTION AND 1966 PRIMARY ELECTIONS, IN PERCENTAGE POINTS

Variable	1966 Primary Elections		1964 Presidential Election	
	b	(s)	b	(s)
Curriculum				
Academic@				
Vocational-Academic	6.2	(11.4)	-7.8	(9.0)
Vocational-Comprehensive	-10.4	(6.1)	.5	(4.8)
General	-8.3	(6.9)	-2.3	(5.5)
Vocational-Technical	-3.4	(5.2)	-8.1*	(4.1)
Labor Market				
City A@				
City B	-11.7*	(4.6)	-22.5**	(3.6)
City C	-3.5	(4.9)	-2.6	(3.9)
Male	1.7	(4.2)	-1.7	(3.3)
IQ	-.13	(.18)	.05	(.14)
White	-10.3	(5.3)	-6.1	(4.2)
Marital Status				
Married@				
Single	2.4	(4.2)	1.7	(3.4)
Separated, Widowed, Divorced	-11.3	(7.3)	-17.9**	(5.8)
Father's Education	.74	(.64)	.79	(.50)
Percent of Time Employed in Six Years after Graduation	.07	(.08)	.13*	(.06)
Number of Observations	674		674	
Coefficient of Determination#	.01		.09	
Intercept	84.0	(21.0)	75.5	(16.6)
Standard Error of Estimate	46.9		37.0	
Mean of Dependent Variable	66.6	(47.2)	81.6	(38.8)
F-Ratio:				
All Variables	1.62		6.06**	
Curriculum	1.19		1.76	
Labor Market	3.33*		21.13**	
Marital Status	1.94		6.26**	

Notes:

*	significant at the .05 level.
**	significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters the intercept term. The partial regression coefficients of the other dummy regressors of the variable are interpreted as deviations from this regressor.
#	adjusted for degrees of freedom.

TABLE 60

SELECTED INTERACTION EFFECTS ON THE CURRICULUM VARIABLE: POST-GRADUATION VOTING BEHAVIOR IN THE 1966 PRIMARY ELECTIONS, IN PERCENT

Sample Sub-group	Vocational-Academic b (s)	Vocational-Comprehensive b (s)	General b (s)	Vocational-Technical b (s)	N	M (s)	I (s)	SEE	F	$\bar{R}^2$
Total Sample	6.2 (11.4)	-10.4 (6.1)	-8.3 (6.9)	-3.4 (5.2)	674	66.6 (47.2)	84.0 (21.0)	46.9	1.62	.01
Sex										
Male	3.6 (20.8)	-13.5 (10.5)	-9.8 (9.0)	-7.9 (8.0)	266	67.3 (47.0)	64.9 (37.7)	47.1	0.93	.00
Female	8.8 (14.2)	-6.6 (7.9)	-8.6 (11.5)	.6 (7.2)	408	66.2 (47.4)	100.2 (26.6)	47.1	1.40	.01
IQ										
89 or less	31.0 (60.0)	-26.2 (21.9)	-18.6 (22.4)	-12.5 (18.4)	76	75.0 (43.6)	62.9 (32.5)	44.7	0.70	.00
90 - 110	-.5 (14.5)	-15.6* (7.9)	-12.4 (8.8)	-11.2 (6.6)	433	64.9 (47.8)	78.0 (13.4)	47.2	1.91*	.02
111 and above	24.7 (21.7)	8.2 (11.6)	-4.6 (14.2)	20.8* (10.5)	165	67.3 (47.1)	52.7 (28.7)	47.4	0.78	.00
Race										
White	3.2 (12.6)	-13.1 (6.8)	-6.9 (7.4)	-2.9 (5.6)	565	65.1 (47.7)	88.3 (24.4)	47.4	1.61	.01
Nonwhite	19.9 (27.3)	1.4 (16.0)	-11.7 (21.7)	-6.5 (15.2)	109	74.3 (43.9)	21.4 (50.6)	44.2	0.87	.01
Marital Status										
Single	12.9 (20.8)	-20.0 (11.7)	-16.0 (14.0)	-6.5 (10.4)	187	71.1 (45.4)	110.3 (40.0)	44.9	1.50	.04
Separated, Widowed Divorced	31.0 (67.2)	-18.5 (28.9)	-6.5 (38.1)	4.2 (23.4)	46	54.3 (50.4)	48.3 (103.3)	54.0	0.46	.00
Married	1.2 (14.2)	-4.7 (7.6)	-4.9 (8.4)	-2.7 (6.4)	441	66.0 (47.4)	67.9 (27.0)	47.5	0.89	.00
Father's Education										
Less than 12 years	-.2 (17.0)	-19.0* (7.6)	-14.9 (8.7)	-9.9 (6.4)	472	65.0 (47.7)	100.8 (24.3)	47.4	1.54	.01
12 years or more	13.0 (15.5)	8.2 (10.7)	2.2 (11.8)	6.8 (9.6)	202	70.3 (45.8)	59.6 (40.6)	45.5	1.21	.01

Notes:

*	significant at the .05 level.
**	significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error.
N	is the number of observations.
M	is the mean of the sample sub-group.
I	is the intercept.
SEE	is the standard error of the estimate.
F	is the F-statistic for the equation.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

a In addition to the curriculum variable, the equation for each sample sub-group contains all the other variables represented in the Table except the variable for its own sub-group. In addition, each equation has the independent variable representing the percent of time employed in the six year post-graduation period. Thus the equation for males contains the following variables: Curriculum--academic, vocational-academic, vocational-comprehensive, general and vocational-technical; City--A, B and C; IQ--in continuous form; Race--white and nonwhite; Marital Status--married, single, and separated, widowed or divorced; Father's Education--in continuous form; and, the percent of time employed in the six year post-graduation period.

TABLE 61

SELECTED INTERACTION EFFECTS ON THE CURRICULUM VARIABLE: POST-GRADUATION VOTING BEHAVIOR IN THE 1964 PRESIDENTIAL ELECTION, IN PERCENT

Sample Sub-group	Vocational-Academic b (s)	Vocational-Comprehensive b (s)	General b (s)	Vocational-Technical b (s)	N	M (s)	I (s)	SEE	F	$\bar{R}^2$
Total Sample[a]	-7.8 (9.0)	.5 (4.8)	-2.3 (5.5)	-8.1* (4.1)	674	81.6 (38.8)	75.5 (16.6)	37.0	6.06**	.09
Sex										
Male	8.0 (16.4)	-13.8 (8.3)	-3.1 (7.1)	-11.1 (6.3)	266	80.4 (39.7)	70.7 (29.8)	37.2	4.14**	.12
Female	-8.8 (11.0)	6.7 (6.1)	-4.8 (8.9)	-5.2 (5.6)	408	82.4 (38.2)	67.7 (20.6)	36.5	4.20**	.08
IQ										
89 or less	-5.7 (53.0)	-22.9 (19.4)	-18.6 (19.8)	-34.9* (16.3)	76	81.6 (39.0)	80.1 (28.8)	39.5	0.85	.00
90 - 110	-15.8 (11.6)	.6 (6.3)	-3.1 (7.0)	-8.4 (5.3)	433	79.2 (40.6)	83.9 (10.8)	37.8	6.65**	.13
111 and above	19.2 (15.0)	5.5 (8.0)	-4.1 (9.8)	5.8 (7.2)	165	87.9 (32.7)	79.1 (19.9)	32.8	0.95	.00
Race										
White	-6.3 (9.9)	-.1 (5.3)	-1.6 (5.8)	-8.5 (4.4)	565	80.9 (39.4)	79.5 (19.2)	37.2	6.53**	.10
Nonwhite	-6.5 (21.9)	3.1 (12.9)	.2 (17.5)	-4.7 (12.2)	109	85.3 (35.6)	11.6 (40.7)	35.5	1.00	.01
Marital Status										
Single	-28.4 (15.6)	2.4 (8.8)	-2.2 (10.5)	-4.0 (7.8)	187	87.2 (33.5)	89.4 (30.0)	33.5	1.03	.01
Separated, Widowed, Divorced	-20.4 (56.1)	-18.8 (24.1)	-36.1 (31.8)	-32.7 (19.6)	46	63.0 (48.8)	115.1 (86.3)	45.1	1.69	.14
Married	-.2 (11.2)	1.4 (6.0)	.8 (6.6)	-7.2 (5.1)	441	81.2 (39.1)	63.3 (21.4)	37.6	4.26**	.08
Father's Education										
Less than 12 years	-17.6 (13.2)	-2.9 (6.0)	-7.9 (6.8)	-12.4* (5.0)	472	81.4 (39.0)	92.2 (19.0)	37.0	5.25**	.09
12 years or more	4.6 (12.8)	10.0 (8.9)	6.9 (9.8)	-1.4 (7.9)	202	82.2 (38.4)	42.6 (33.5)	37.6	1.68	.05

Notes:

*	significant at the .05 level.
**	significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error.
N	is the number of observations.
M	is the mean of the sample sub-group.
I	is the intercept.
SEE	is the standard error of the estimate.
F	is the F-statistic for the equation.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

[a] In addition to the curriculum variable, the equation for each sample sub-group contains all the other variables represented in the Table except the variable for its own sub-group. In addition, each equation has the independent variable representing the percent of time employed in the six year post-graduation period. Thus the equation for males contains the following variables: Curriculum--academic, vocational-academic, vocational-comprehensive, general and vocational-technical; City--A, B and C; IQ--in continuous form; Race--white and nonwhite; Marital Status--married, single, and separated, widowed or divorced; Father's Education--in continuous form; and, the percent of time employed in the six year post-graduation period.

And except in one case, there is no statistically significant difference between the 1966 primary election voting behavior of the academic and the vocational-technical curricula. For the sub-sample of graduates having an IQ of 111 and above vocational-technical curriculum graduates voted about 21 percent points more in the 1966 primaries than did academic curriculum graduates.

The statistical results with respect to voting behavior in the 1964 Presidential election are similar in many ways to the above results. Six of the 12 equations for the sub-groups are statistically significant at the .01 level. For these equations, the independent variables explain approximately ten percent of the variation in voting behavior in the 1964 Presidential election. However, it is again the case that the curriculum variable is not statistically significant for any of the equations of the sub-group. In comparing the voting behavior between vocational-technical and academic curriculum graduates, only two of the relationships are statistically significant. For those graduates whose IQs are 89 or less vocational-technical graduates voted 34.9 percent less in the 1964 Presidential election than did academic graduates. For those graduates whose fathers had less than 12 years of education, vocational-technical graduates voted 12.4 percent less than did academic graduates. For all the other sub-groups there is no statistically significant difference between the voting behavior of the two curricula in the 1964 Presidential election. Thus, the general conclusion must be that even for important sub-groups of graduates within the sample of 674, there were, on net, no statistically significant differences among curricula either for voting behavior in the 1966 primary elections or in voting behavior in the 1964 Presidential election.

C. Relation of Curriculum to Career Interests

Another important dimension of the non-monetary effects of vocational-technical education lies in the degree to which one's education conforms to his career interests and the skill needs of his job. Table 62 displays the results achieved in investigating this problem.

Table 62 indicates that there is a statistically significant relationship between curriculum and career interest as well as curriculum and the source of skills in relation to jobs held. Vocational-technical graduates have .28 fewer jobs which do not fit in at all with their career interests than do academic graduates. This result is quite reasonable. By the very fact that they are in a vocational-technical program, these graduates have already exhibited a more immediately stable career interest, and since they also tend to get more training-related jobs, it is not at all unlikely that these jobs will fit in with their career interests.

TABLE 62

TRAINING SPECIFICITY AND CAREER RELATIONSHIP OF EMPLOYMENT FOR SENIOR HIGH SCHOOL GRADUATES

Variable	Number of Times a Job "Does Not Fit in at All" With Career Interests		Number of Times Graduate Learned Most About His Job in High School Shop or Classes		Number of Times Graduate Learned Most About His Job in an Apprentice Program or Formal or Informal On-Job-Training	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	-.44	(.28)	.39	(.29)	-.60	(.34)
Vocational-Comprehensive	-.30	(.15)	.45**	(.16)	-.46*	(.18)
General	.08	(.18)	.50**	(.18)	.07	(.21)
Vocational-Technical	-.28*	(.13)	.66**	(.13)	-.42	(.16)
Labor Market						
City A@						
City B	-.05	(.12)	.14	(.12)	-.20	(.14)
City C	-.07	(.12)	-.04	(.12)	.19	(.14)
Male	.35**	(.10)	-.58**	(.10)	.43**	(.12)
IQ	-.002	(.004)	.004	(.004)	.005	(.005)
White	.64**	(.13)	-.13	(.13)	-.37*	(.16)
Marital Status						
Married@						
Single	.11	(.10)	-.01	(.11)	-.13	(.12)
Separated, Widowed, Divorced	-.35	(.18)	-.40*	(.18)	-.13	(.22)
Father's Education	.02	(.02)	.003	(.016)	.02	(.02)
Number of Observations	678		678		678	
Coefficient of Determination#	.06		.08		.05	
Intercept	1.36	(.50)	.15	(.51)	1.63	(.60)
Standard Error of Estimate	1.18		1.20		1.40	
Mean of Dependent Variable	0.69	(1.22)	0.76	(1.25)	1.78	(1.43)
F-Ratio:						
All Variables	4.90**		5.85**		3.87**	
Curriculum	2.70*		6.07**		3.87**	
Labor Market	.18		1.04		3.21*	
Marital Status	2.29		2.36		.68	

Notes:

*	significant at the .05 level.
**	significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters the intercept term. The partial regression coefficients of the other regressors of the variable are interpreted as deviations from this regressor.
#	adjusted for degrees of freedom.

The academic graduate, on the other hand, has chosen a different route of training, job search and job selection. By the fact that he has taken nonspecific training, he has indicated some uncertainty as to his career interests and a desire to hedge before making his ultimate choice. The more general training, other things equal, may allow for more job options. To the extent that a job requires specific skills however, general training will tend to result in exclusion from that job.

Over time, as the academic graduate shops around among jobs and acquires more on-the-job training, he will be more likely to hit upon a job or develop skills that are in accord with his career interests. Consistent with this is the fact that the vocational-technical graduate is more likely than the academic graduate to have a job whose skills he learned most about in high school shop or classes. Conversely, he is less likely than the academic graduate to have jobs whose skills are picked up in an apprentice program or on formal or informal on-the-job training. In short, it is fairly clear that vocational-technical training has in part done what it set out to do: prepare workers for employment in specific skill areas in such a fashion that these workers do, in fact, find employment in their areas of training. Of course, it is not clear whether the net impacts of curriculum shown in Table 62 are large or small. There is no standard in this study by which to make such judgments.

D. Economic Aspirations

A final source of bias in this study may lie in the differential psychological and motivational characteristics among the graduates of the different curricula. To test for this a series of three questions was asked of the graduates concerning their economic aspirations. (See Table 63 as well as Appendix I, questions H-5 through H-7.)

Among the independent variables in the model which investigate economic aspirations the curriculum variable is never statistically significant. Also, whether one considers the graduate's appraisal of monthly earnings needed for a barely adequate standard of living or whether one considers the other two aspiration variables, there is no statistical difference between the vocational-technical graduates and the academic graduates. Thus, if these measures are an index of motivational and psychological patterns of behavior, it does not appear that students of different aspiration levels and motivation selectively filter into different curricula. Nor does it appear that curriculum itself has any relationship with motivation and aspiration, given these indices. This is an important finding even though his sample has a composition different from the sample used to estimate economic benefits, for it tends to eliminate a potential source

TABLE 63

ECONOMIC ASPIRATIONS OF SENIOR HIGH SCHOOL GRADUATES, IN DOLLARS

Variable	Monthly Earnings Needed for A Barely Adequate Standard of Living		Monthly Earnings Needed to be Really Well Off		Monthly Earnings Expectations When Career is Well Established	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	10	(31)	-199	(122)	-61	(150)
Vocational-Comprehensive	10	(17)	-31	(66)	-49	(81)
General	- 3	(19)	80	(76)	98	(93)
Vocational-Technical	- 9	(15)	- 65	(57)	-97	(70)
Labor Market						
City A@						
City B	9	(13)	- 61	(50)	-102	(65)
City C	60**	(13)	227**	(52)	171**	(64)
Male	29**	(11)	147**	(43)	310**	(53)
IQ	.32	(.49)	3.46	(1.90)	3.13	(2.33)
White	54**	(14)	79	(56)	124	(69)
Marital Status						
Married@						
Single	-94**	(12)	-224**	(45)	-179**	(56)
Separated, Widowed Divorced	-95**	(20)	-274**	(79)	-177	(97)
Father's Education	2.2	(1.7)	3.9	(6.8)	14.3	(8.3)
Number of Observations	678		678		678	
Coefficient of Determination#	.17		.12		.12	
Intercept	351	(56)	399	(217)	227	(267)
Standard Error of Estimate	130		507		623	
Mean of Dependent Variable	444	(143)	845	(540)	816	(662)
F-Ratio:						
All Variables	12.92**		8.54		8.30**	
Curriculum	.55		1.92		1.68	
Labor Market	10.53**		14.56**		7.98**	
Marital Status	12.05**		6.27**		3.23*	

Notes:

*	significant at the .05 level.
**	significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters the intercept term. The partial regression coefficients of the other regressors of the variable are interpreted as deviations from this regressor.
#	adjusted for degrees of freedom.

of bias in the estimation of monetary benefits attributable to the different curricula; a bias which might arise due to the fact that graduates with greater motivation and higher aspiration levels might tend to work harder or more effectively and hence tend to earn more.

The relationships between the three measures of aspiration and the other independent variables are unexceptional. As one might expect, the aspirations levels of males are significantly higher than those of females. Economic pressure is partly the reason for this. Cultural and economic aggressiveness built into the male is another. Those who are not married have lower aspiration levels, partly because nonmarriage tends to imply lower economic pressure. With respect to barely adequate levels of earnings, whites have higher aspirations than nonwhites. However, there is no statistically significant difference between whites and nonwhites with respect to monthly earnings needed to be really well off or with respect to earnings for ultimate career expectations. Even though the graduates of City C have statistically significant higher aspiration levels than the graduates of City A, there is no necessary theoretical justification for this and the fact is merely noted.

E. Summary

As a general statement it can be noted that with respect to the non-economic indices of benefit and performance, curriculum is not a statistically significant variable nor is there any statistically significant difference between graduates of the vocational-technical curriculum and graduates of the academic curriculum. Differential voting behavior presents a mixed picture in this regard while there is clearly no difference with respect to aspiration levels.

Curriculum does have a statistically significant impact with respect to the non-monetary measures of benefit presented in Table 62. Generally, vocational-academic graduates are more likely to have a job which fits in better with their career interests. In-school instruction is generally more immediately relevant to the job the vocational-technical graduate has than it is to the job the academic graduate has.

CHAPTER XII

VOCATIONAL EDUCATION AND THE EMPLOYER

A. Introduction

This chapter attempts, first, an analysis of specific theoretical questions surrounding the relationship between the provisions of vocational-technical education and the employer. Second, limited empirical analysis of the relationships between vocational-technical education and the employer is also presented. Third, on the theoretical side, it seeks answers to such questions as: under what conditions will employers pay for skill training and which types of employers are most likely to pay? Should most vocational-technical education take place within the firm or within the formal school? Fourth, it seeks to analyze different conceptions of shortage, since the appeal to the existence of a shortage is made when employers seek a further increase in supply for a given skill. Finally, it seeks to identify potential gainers and losers in response to local or regional efforts at industrial location.

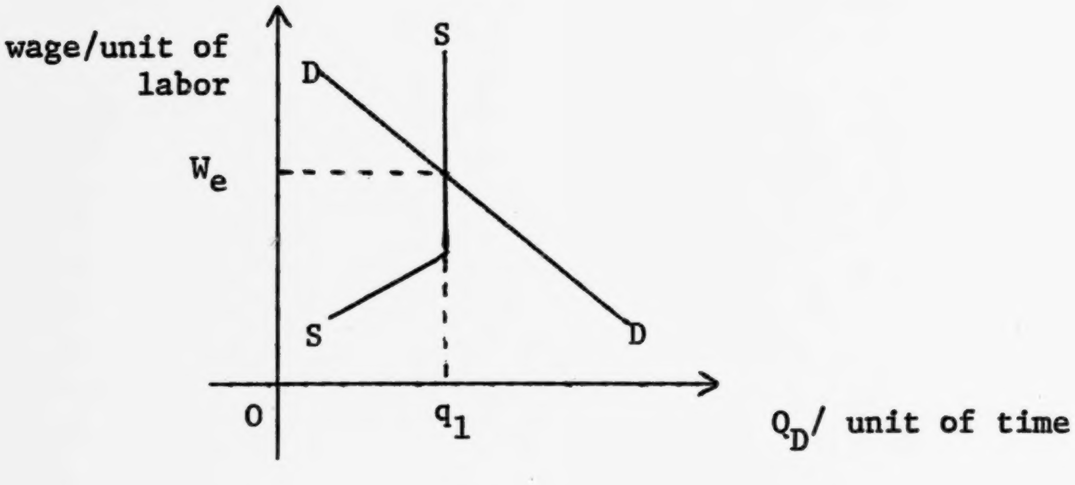
On the empirical side, this chapter attempts to identify the extent to which firms seek to employ vocational-technical graduates. It also discusses whether economic recognition is made by firms of the presumably higher level of qualification of the vocational-technical senior high school graduate as distinct from the graduates of comprehensive senior high schools. Finally, an effort is made to identify any possible extra costs that firms may incur if they hire recent comprehensive senior high school graduates rather than the graduates of vocational-technical senior high schools. If such extra costs are incurred, then the perceived benefits to vocational-technical education estimated in Chapter VIII are even larger and should be taken into account.

B. Vocational Education and Shortage Skills

The argument is often made that one of the major benefits of vocational-technical schools lies in the ability to rectify short-run shortages in needed skills. To protect themselves, often illogically, against charges of subsidizing a particular firm, school districts often require that more than one firm in a community come forth with a plea for assistance in easing a bottleneck in a given skill. The fact that more than one firm comes forward is taken as at least partial insurance against an unwarranted subsidy being given to a particular firm. However, it is quite likely, as will be demonstrated, that what may result is simply a subsidy to a group of firms. An investigation, however, of two types of shortage is necessary before proceeding further.

Structural Shortage versus Non-structural Shortage.[1] Figures 4 and 5 display two types of shortage. Figure 4 illustrates a structural shortage;

Figure 4. Structural Shortage for Skill A.



Skill A

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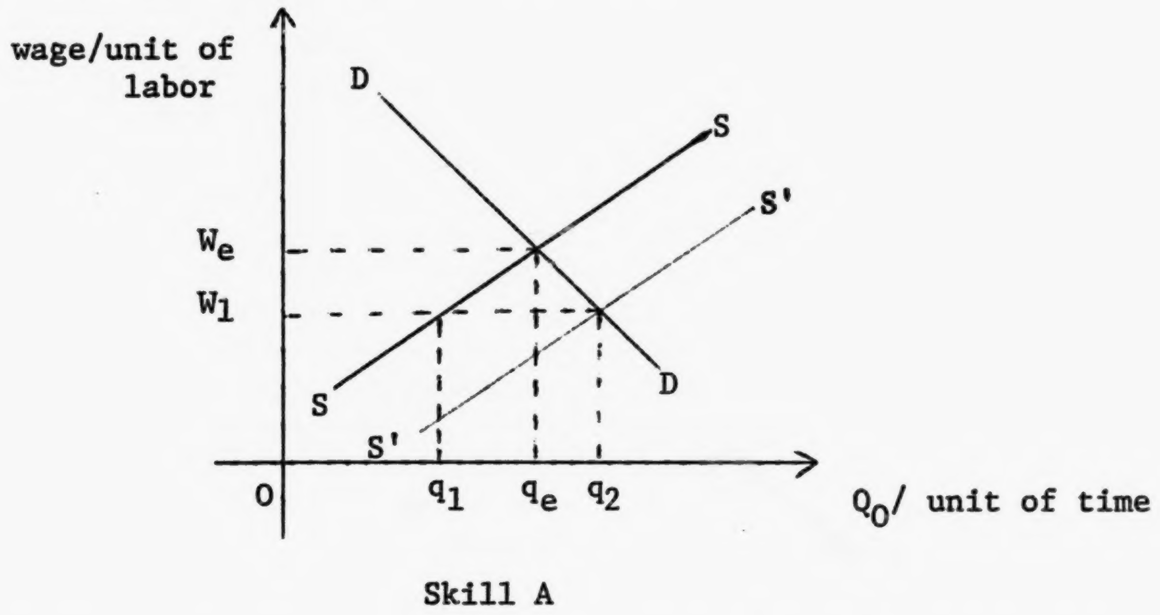
[1] One useful definition of a "shortage" is given by the situation wherein "the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past." See David S. Blank and George J. Stigler, The Demand and Supply of Scientific Personnel, (New York: National Bureau of Economic Research, 1957), p. 24. Italics are in the original.

Figure 5 illustrates a non-structural shortage. In Figure 4, a structural bottleneck in Skill A exists, since, for whatever reason, the supply curve for Skill A becomes vertical once the quantity $^{O}q_1$ is brought forth. Beyond this point, even if a firm offers a higher wage rate, no further quantity will be supplied. The firm could not hire additional workers once the quantity $^{O}q_1$ was supplied. There, thus, exists a structural bottleneck in the market for Skill A. The role of vocational-technical schools could be to increase the supply of workers in Skill A and thus shift the supply curve to the right or change its slope beyond point q_1 and ease the shortage.

Figure 5. Non-structural Shortage for Skill A.



In Figure 5, the wage rate being offered is OW_1, which is less than the equilibrium wage rate OW_e which would have to be paid if supply and demand were in equilibrium. At the wage rate OW_1, only $^{O}q_1$ units of Skill A are being supplied, while $^{O}q_2$ units of Skill A are being demanded. There is a shortage of Skill A equal to q_1q_2. However, this is a shortage which could exist because the firms demanding Skill A are unable or unwilling to pay a wage rate higher than OW_1. If they can convince a vocational-technical school that there exists a "shortage," then, when this school trains more workers in Skill A, the supply curve can be shifted from SS to S'S', thus wiping out the shortage and enabling the wage rate OW_1 to be maintained, This latter case does not represent a structural shortage, however, since by offering higher wage rates, a rate equal to OW_e, the result would be to automatically elicit a greater supply of Skill A without necessarily having to incur the cost of having a vocational-technical school commit resources to the training of these additional workers. Thus a more socially desirable way for the shortage to be eliminated might be to offer wage rates equal to the market, or equilibrium, wage rate for that skill. If the firm would be forced out of business due to this action, there is reason to suspect that society perceives a more efficient alternative use for the resources tied up in that firm. It is important to note that while the individual workers may receive a positive gross gain from this training, a higher net return could have been gained both for them and for society by applying the resources elsewhere since the firm or industry was already operating under high cost, inefficient conditions.

The closure of an uneconomic firm or industry may result in shifts in income distribution. For instance, income will shift away from the present employer in this particular firm or industry. The choice of which action to pursue, then, depends in part on the income distribution preferred by the community or society in question. In any event, it seems clear that the practice of training large numbers of workers in skills that seem to be in chronic "shortage" has occurred and continues to occur in the training in such low wage, low prestige skills as nurses aides and waitresses. Especially with nurses aides, it appears that a variety of institutional constraints exists to keep wages low, thus resulting in high turnover. Society, requesting these services at low rates, finds itself in a position of having to subsidize investment in this skill to assure a given supply of nurses aides, given the high attrition rate due to low wages. Here, the expenditure is essentially a subsidy to the health industry, enabling it to charge lower rates to customers by keeping costs lower with an assured labor supply at the lower wage rates. The "benefits" to this retraining are in the form of lower medical rates, then, and are at least partially cancelled by the training subsidy. Income is shifted toward the users of the health industry and away from the non-users to the extent that both pay taxes to support such training. There is no necessary social gain from this tactic other than the satisfaction society achieves from being able to choose a social policy route more pleasing to its social welfare function, if, indeed, it is doing this in some rational fashion.

One final effect should be noted. First, as will be shown below, whether the training which occurs to ease such a shortage is a subsidy to the firm or the worker will depend on whether the skill is specific to the firm or industry or whether it is a general skill.[2]

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[2] See Gary Becker, Human Capital, op. cit., pp. 18-29, for a discussion of the differences between specific and general training. General training is that skill acquisition which raises one's productivity equally in all firms. Specific training raises productivity in a given firm to which the training is specific, but in no other firm, should the worker transfer.

If it is specific to the firm or industry, the training represents a subsidy to the firm or industry. But even if it is a general skill whose supply is being increased and, thus, a subsidy to the individual, the firm or industry will benefit relative to other firms or industries to the extent that it will be paying lower wage rates than it would otherwise have had to.

C. Location Incentive

A common benefit attributed to the presence of a vocational-technical school is that it provides a locational incentive for firms. Several problems exist with respect to this assertion. First, if all areas have vocational schools, the net locational effects from such schools will be small or zero. Second, the locational effect of a school is only one of several locational effects so that net benefits should be weighted by the probability of firm location, given the presence of a vocational school, holding all other marginal location effects constant. This will give an estimate of new potential locational benefits of the vocational-technical school. Third, problems exist with respect to the possible inter-regional shifts in income distribution. Given full employment, location of a firm in a given area as a result of the normal process of economic expansion results in an unambiguous increase in output for society, though income redistribution effects again occur among groups and regions. Some account should be taken of the external effects of this income distribution in making assessments concerning the impact of this action on total social welfare.

To the extent that the individual community has trained workers in skills highly specific to that firm, the firm has been subsidized by the community. The community should treat this subsidy as a cost to itself and balance this against the benefits of the extra or net increase in earnings flowing from having that particular firm in the area. If the skills are specific to that particular firm and the firm decides to move and leave the community and its workers stranded, community welfare will be reduced, since the stranded workers will have been trained in skills which are irrelevant to all other firms within or without the region where they might seek new employment.

Furthermore, given the presence of unemployment in the economy, the tactic of inducing industry to an area, with the promise of a community subsidy in the form of a work force trained in firm-specific skills, can only redistribute unemployment as well as incur the loss involved in the stranding of a labor supply in the region the firm vacated. The workers of this region cannot employ their firm-specific skills elsewhere. The amount invested in training by the firm-receiving community represents a net loss of benefit to society as a whole. Finally, in the case where a worker can find a job in a different community and where the skills in both communities are specific to the worker and not to the firm, and, hence, can be marketed to other firms and industries, there is no net increase in welfare to society but a simple redistribution of the losses of unemployment between the two communities, with total unemployment and output remaining the same for society.

In sum, care should be taken in attributing industrial development benefits to the mere fact of the establishment of a vocational-technical school in a region. First, the net extent to which such an action is perceived as a location incentive by firms is not clear. This assertion of a locational effect still lies in the realm of a poorly tested hypothesis. Second, even if such a location incentive exists, care should be taken in the identification of benefits. Under the most unfavorable assumptions, a net loss could occur to society even though a given community perceived a gain.

D. Empirical Findings

Sample Structure. Fifty employers were selected on a systematic basis from lists of major employers in Cities A, B and C. No effort was made to stratify these firms on any basis such as size or type of industry. It was possible to interview 129 of these firms. Eighty-six of these firms employ 1 to 99 workers, 28 employ 100 to 499 workers and 15 employ 500 or more workers. Two of these firms are in contract construction. Four are in finance, insurance or real estate; one is in government; 58 are in manufacturing; 38 are in services, transportation and communication; and 26 are in wholesale and retail trade.

Association between Firms and Vocational-Technical Education. To what extent are firms interested in hiring vocational-technical graduates? To what extent are they in contact with the vocational-technical schools? As Table 64 shows, large firms are much more likely to have an interest in the specific curricula of the persons they hire than are small firms. This is reasonable since larger firms are more likely to need specialized people. The possibilities of division of labor and specialization of functions are greater in large firms, thus creating an interest in specific skills a person has, in addition to his general qualifications. The small firms elicit almost no interest in the particular high school curriculum of a newly hired person. The small firms are also less likely to have been contacted by counselors or placement officers from the public school systems of the three cities. Of course, from the counselors' or placement officers' viewpoints, greater success in placement is likely in contacting the larger firms since in absolute terms they are more likely to have more vacancies and the probability of placement is higher. In terms of total effort expended, it is more reasonable for such officials to check mainly with the larger firms when trying to determine skill needs in the local labor market. Of course, unless the distribution

TABLE 64

FIRM BEHAVIOR WITH RESPECT TO EMPLOYEE TRAINING

Number of Firm Employees	Yes #	Yes %	No #	No %	Not Ascertained #	Not Ascertained %
	Do you (the firm) keep any records which enable you to distinguish the high school curriculum of each of the persons your firm hires?					
1-99	6	7.0	79	91.9	1	1.1
100-499	4	14.3	21	75.0	3	10.7
500 and over	4	26.7	9	60.0	2	13.3
	Has anyone from the public high schools, such as a placement officer, teacher or guidance counselor, ever tried to place newly graduating high school students with you as workers?					
1-99	35	40.7	50	58.1	1	1.2
100-499	8	28.6	19	68.8	1	2.6
500 and over	8	53.3	7	46.7	0	0.0
	Has anyone from the vocational-technical schools in this city ever talked with you to determine if the vocational-technical schools could serve your needs better?					
1-99	24	27.9	61	70.9	1	1.2
100-499	7	25.0	20	71.4	1	2.6
500 and over	6	40.0	8	53.3	1	6.7

of skills and needs for specific skill types are the same in the small as in the large firms, this implies that, in general, the skill and training needs of the small firms are to some degree unmet.

As Table 65 shows, 33 percent of small size (1-99 employees) firms require some formal skills for the jobs while 27 percent of large firms (500 and over) need some formal skill requirements for the job. The overwhelming majority of firms in this sample do not hire only vocational-technical high school graduates for the jobs. This phenomenon can be explained by the fact that most of the firms give on-the-job training. It seems, as Table 65 shows, larger firms emphasize on-the-job training more heavily than do the small firms. Small firms want employees to be already equipped with skills in specific operations which these firms can adopt without further expense to their particular operations.

Finally, it is seen that within the last 12-month period (1967-68) the total number of employees who have had some vocational-technical training at the high school level and who were hired by firms of all sizes amounts to 567 employees. In the past year 64 small (1-99 employees) firms hired an average of 2.11 employees who had some vocational-technical training. Sixteen medium-size (100-499) firms hired an average of 9.87 such employees each. Six large firms (500 and over) hired an average of 45.67 employees with some vocational-technical training at the secondary level.

Economic Benefit at the Firm Locus. Does a vocational-technically trained person gain an earnings advantage (if his training is general in nature) or does the firm who hires him gain an economic advantage (if the person's training is specific to that firm)? The assumption in this study is that the training provided by the vocational-technical schools is general in nature. Hence, any earnings benefits accrue to the vocationally trained student and not to the firm. Thus, if a subsidy exists, it is to the student and not to the firm.

As Table 65 shows, the overwhelming majority of firms in this sample provide some form of formal non-on-the-job training, formal on-the-job training or informal on-the-job training. This training lasts 18.19 weeks, on the average, and two-thirds of the firms have job training programs which fall in a range of 15.70 to 20.68 weeks in length. However, the training for those employees from the vocational-technical senior high schools is 12.64 weeks shorter than is the training period for other types of high school graduates. Two-thirds of the vocational-technical employees have a differential in training which falls in a range of 9.73 to 15.55 weeks shorter. During this training period, vocational-technical graduates earned $3.00 per hour on the average while the graduates from the other high school curricula earned $1.78 on the average. The differential is $1.22 per hour. For a forty-hour week, this represents a $48.80 earnings differential while in training in favor of the vocational-technical graduates

TABLE 65

FIRM BEHAVIOR WITH RESPECT TO SENIOR HIGH SCHOOL GRADUATES PLACEMENT

Number of Firm Employees	Yes #	Yes %	No #	No %	Not Ascertained #	Not Ascertained %
	Do any formal skill requirements exist for this job, such as fulfillment of an apprenticeship period or graduation from a private or public trade or vocational-technical school?					
1-99	25	32.9	51	67.1	0	0.0
100-499	12	44.4	15	55.6	0	0.0
500 and over	3	27.3	8	72.7	0	0.0
	Do you (the firm) hire only a vocational-technical high school graduate for this job?					
1-99	12	15.7	59	77.6	5	6.7
100-499	3	11.1	24	88.9	0	0.0
500 and over	1	9.1	10	90.9	0	0.0
	Does your organization give any training for this job, such as formal non-on-the-job training, formal on-the-job training, or informal on-the-job training?					
1-99	59	77.6	16	21.1	1	1.3
100-499	23	85.2	4	14.8	0	0.0
500 and over	10	90.9	1	9.1	0	0.0

of the sample of firms. Thus, for the firms in this sample which have any type of training program, vocational-technical training both shortens the training period and results in a higher hourly wage rate while in training. The better performance of vocational-technical graduates during the training period may imply a higher productivity of vocational-technical graduates than other high school curricula graduates, although we do not have any information about their differences in productivity in the sample.

In short, for the firms sampled in this study, during the training period it costs the vocational-techncial employees about $245 less to receive the additional training he gets in the firm. Or, which is the same thing, he received $245 more in monetary benefits by virtue of the fact that he is a graduate of (or took some training in) a vocational-technical high school. These money benefits, of course, increase the internal rate of return to vocational-technical training. Finally, these positive results should be tempered by the fact that we do not know the degree of statistical significance of these training costs differentials. Nor, although a systematic sampling of 50 employers was made in each city, is the degree of representativeness of our employer sample known. First, because responses were not gained from all 50 employers in each city. Secondly, the sample was not drawn on a statistically random basis.

E. Summary

Serious conceptual issues remain unresolved in the discussion of whether or not vocational-technical senior high schools provide net advantages to a community and especially society when efforts are made to use such schools as lures to industry location.

The practical issue, of whether or not the shortage skills requested by a set of forms for vocational-technical schools for training represents a time structural skill shortage, is still to be resolved. As matters stand now, current techniques to avoid subsidies to a set of firms paying below equilibrium wage rates are probably ineffective. The result is that resources are malallocated in society and the students, in particular, could benefit more by being trained in other than these particular skills.

Finally, for the study sample of employers who do provide some form of training for new employees, vocational-technical graduates or employees who have had some vocational-technical training, benefit relative to those new employees who have had no such training. For the study sample, the benefits amount to over $200 per new vocational-technical employee. Of course, the benefit equations in Chapter VIII pick up the fact that vocational-technical employees have a shorter training period in addition to higher average wages after training in the firm. The better performance of vocational-technical graduates during the training period may imply a higher productivity of vocational-technical graduates than graduates from the other high school curricula, although we do not have any information about their differences in this sample.

CHAPTER XIII

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

A. Introduction

The Issues. In recent years, and particularly since the Vocational Education Act of 1963, investment in vocational education has been substantially increased. It is argued that the need for skilled labor is overwhelming, and that the technology of today no longer requires a high proportion of unskilled and untrained workers. At the same time, more young people are entering the labor force now than at any time in the past. The available educational programs must therefore cater to all American youth, not only to those who attend college.

Yet are the current programs really successful? Is the expenditure worthwhile? Would an increase or a reduction in investment in vocational education achieve greater benefits?

This report concludes that, under the conditions specified in the study, additional public funds should be spent on the vocational-technical curricula rather than on the nonvocational-technical senior high school curricula. Yet, as it is currently constituted, there is no specific information on how much more should be spent. However, by comparing the costs of the different curricula with benefits measured in terms of earnings, the return to investment in vocational-technical education was shown to be considerably greater than the return to investment in the alternative curricula.

Framework of Analysis. This study is concerned with the optimum allocation of public resources in education, in particular between vocational-technical education and alternative curricula for non-college attending students. For this purpose, measurement is needed of both costs and benefits. Costs by themselves can neither be taken as an indication of quality or costliness, nor can benefits be evaluated without taking account of costs. If two alternative programs were mutually exclusive, the average cost of each would need to be compared with the average benefit, in order to reach a decision. However, if the two programs are not mutually exclusive, measurement of average cost and benefit will not suffice. In this case the optimum amount of public expenditure for two educational programs will be an allocation of funds such that the marginal benefit-marginal cost ratio for one program is equal to the marginal benefit-marginal cost ratio for the other; or in other words, one should allocate funds to each program up to the point where the additional benefit from an additional dollar spent on the two educational processes is equal.

Although the theoretical criterion for the optimum allocation of expenditure is clearcut, there are three major difficulties when considering investment in education. First, it may be difficult to derive an accurate measurement of benefits or costs. Many of the benefits, in particular, are non-economic in nature. Second, both benefits and costs are likely to be more general than those measured by simple economic indices. Last, the emphasis in the study is upon the allocation of public resources. Hence, the analysis must be performed from the viewpoint of society, and based upon the concept of social utility or social welfare. Social, governmental and private costs and benefits do not necessarily coincide with each other or with monetary or accounting costs and benefits.

However, in other areas of government and private investment, systems have already been introduced to measure the relative desirability of alternative programs. One of the most important instruments is the program-planning-budget system, which is a combination of program budgeting and systems analysis. The former contains two important pieces of information for decision-makers: 1) the ultimate and intermediate objectives of the planned program, and 2) the information on financial resource allocation needed to achieve the objectives. The latter is essentially a quantitative analysis to provide a rational criterion for decision-making. There are two closely related forms of systems analysis; cost-effectiveness analysis where the quantification is not solely in monetary terms, and cost-benefit analysis where quantification of costs and benefits is in monetary terms. Both of these types of analyses can be used to indicate the optimum allocation among alternative educational investments. However, the application of cost-effectiveness or cost-benefit analysis is less valid for those public investments or expenditures occurring directly on the human agent, such as education, than it is for public investments in goods, such as dams or highways.

There are four main steps involved in the study. First, all costs and benefits were identified and representative data were collected. Second, the conceptual difficulties were resolved, where possible, and the appropriate criteria for investment decisions were determined. Third, the data were analyzed by statistical methods, and, by comparing costs and benefits, the return to the investment was ascertained. Finally, other related issues which might affect the analysis were considered.

Description of the Data--Costs. Three cities were selected and, with the cooperation of the school officials, data were collected by curriculum from each school system. In Cities A and B, the vocational-technical curriculum is taught exclusively in the vocational-technical senior high schools, while the other curricula (academic, general and vocational-comprehensive) are taught in the comprehensive senior high schools. In City C, there are also vocational-academic senior high schools which produce graduates with both academic and vocational-technical curriculum majors. The money cost data are structured on the basis described in Financial Accounting for Local and State School Systems: Handbook II, since the three cities tended to be guided by this manual when reporting costs. Although the main concern is with marginal costs, total and average costs were also measured.

There was not sufficient uniformity of the available data to make comparison easy between cities. In City A, incomplete but usable cross-section data were available from fiscal year 1955-56 through 1959-60, and time series data from fiscal year 1946-47 to 1959-60. The total cost was more complete for the school system than for the individual schools. However, as the costs not reported for individual schools were mainly joint costs, this lack of completeness did not seriously affect the determination of marginal costs between vocational-technical and nonvocational-technical senior high school curricula. City B had only incomplete and unusable cross-section data as a function of separate vocational-technical or nonvocational-technical senior high schools. No cost-benefit analysis could be done for City B. City C had the most complete and usable current cost data in the study. Cross-section data were available by type of school from fiscal year 1955-56 to 1961-62.

Description of the Data--Benefits. There is a multi-dimensional increase in welfare associated with education which cannot be evaluated with a single index or measure of benefit such as earnings. Because of the absence of a unique objective measure for the benefits of vocational-technical education, earnings and employment are used as proximate measures. This, therefore, results in the assertion that one of the major objectives in education is to improve economic efficiency and economic welfare, and further that employment and money earnings are appropriate indices by which to measure such welfare. Although the income redistribution effect is not negligible in the measure of net benefit, it is impossible to sort out, given the study constraints, so an analysis of income redistribution effects is not included in the analysis.

The benefit data are based on labor market histories reported by mail questionnaires from a sample of high school graduates from the classes of June and January 1959 and 1960. The histories covered a six-year period following graduation and the total sample size was limited to 1,255. Information on seven sets of independent variables was obtained--curriculum, sex, race, marital status, city of graduation, IQ measures and father's education. The city of graduation variable was designed to control for differences in the educational institutional structure and to represent differing industrial and labor market structures, the price level and employment differentials. Father's education was designed as a measure of socio-economic status and background.

The sample of high school graduates is highly weighted towards females. Other things equal, this will tend to lower the absolute level of measured money and employment benefits, although its effect on benefit differentials between curricula is uncertain. Moreover, for various vocational-technical courses, employment and earnings strongly reflect the distribution of students by sex in each course. Finally, it must be reemphasized that no judgment as to the relative economic efficiency either between cities, over time or among courses, can be made based on a single inspection of the cost data alone or the benefit data alone.

B. Some Theoretical Considerations.

Conceptual Difficulties in Cost Evaluation. Joint costs only present a problem with respect to the estimation of total and average costs. When joint costs occur among two or more programs the total costs of the sharing programs, both joint and specific, should be compared with the total benefits of the sharing programs, both joint and specific. But an independent assessment of each program requires that the marginal benefits of each program, where two or more programs share costs jointly, should be assessed independently of any joint benefits. These marginal benefits, exclusive of any joint effect, should then be compared with the respective marginal costs, exclusive of any joint effects, for each program.

Some costs of education are explicit in nature, such as the money costs paid out for tuition. Other costs are implicit, such as earnings which are foregone while one attends school. Consideration of foregone earnings demonstrates the difficulty in evaluating costs which are implicit in nature. Foregone earnings are a cost to the individual student to the extent that the decision to undertake one's education is a free choice. However, if a substantial number of students move into the labor market, it may change the skill composition of the labor force and reduce the earnings potential of this group of labor market participants. It would be an overstatement to impute foregone earnings based on current relative wages as an element of the cost of education to society even though the current wage structure is relevant for an individual. In this study an attempt was made to measure foregone earnings by estimating the earnings which senior high school dropouts receive from the time they drop out until the time when they would have graduated. However, in each of the three cities there were no statistically significant differences in the earnings in the period prior to projected graduation between the dropouts of the nonvocational-technical and the dropouts of the vocational-technical curricula. Given this limited information, such opportunity costs were therefore not imputed in the study.

The services of the capital plant, equipment, and site acquisition and improvements are not easily evaluated. This study employs replacement costs as a method of measuring capital costs but recognizes that these replacement costs give an upward bias to the measure of capital used. In order to estimate the rate of capital use, account must be taken of the imputed rent or return on the capital investment and of depreciation to the capital stock. This is automatically taken care of by the capital recovery factor, but the disadvantage of the capital recovery factor is that it only gives the average annual amount required to replace the original capital stock and not the actual amount of capital used up in any given year.

One question which has arisen in other studies on the economic value of education, is that concerning the application of adjustment or correction factors to social goods for the purpose of comparing them with goods produced in the private sector of the economy. Education, however, is a precondition for the production, distribution and consumption of private goods, and cannot be compared in an efficiency sense with private goods. Education and private goods are not necessarily market substitutes. Thus, adjustments for such things as excise taxes which are not paid by public school systems, are not made because it is felt that the comparison of private and social goods is not appropriate. However, within education, economic analysis of the relative effectiveness of different educational programs can be performed.

The Rate of Interest. Assuming that all costs and benefits have been measured satisfactorily, the next step is to account for the fact that different investment alternatives are likely to have different time profiles of costs and benefits. For comparability, costs and benefits are reduced to their present value by discounting at a given interest rate. The purpose of discounting is to attach relative weights to these cost and benefit time profiles in order to account for the productivity of investment, social or private time preference, and risk.

Discounting is theoretically justified for a number of reasons. The first is that the interest rate used in discounting represents the opportunity cost of investment funds; that is, invested wealth usually earns a positive rate of return. Thus 'Y' dollars invested today will yield 'Y' + 'X' dollars at some time in the future due to the productivity of the investment, and, reversing this process, the present value of 'Y' + 'X' dollars will be 'Y' dollars when discounted at the appropriate rate. Second, future income is valued less than present income. People have a positive time preference and dislike postponing consumption. Third, risk reduces the value of any given stream of future benefits.

Economic theory and empirical research do not, however, give an answer to the question of choice of rate of interest. There is no uniquely correct empirical interest rate, and the final choice must essentially be based on value judgment. For social investments, the relevant range of empirical rates of interest observed in the market place appears to vary between 4% and 10% and a variety of rates have been used in cost-benefit analyses. Yet the choice is important, for the interest rate used in discounting plays a critical role in deciding between alternative investments. A low rate will discriminate in favor of those investments whose benefits accrue in the distant future as against those whose benefits accrue in the near future.

Not only is there a variety of interest rates to choose from at any one time, but also the use of an unique rate over the entire period may be conceptually incorrect. External circumstances may change, the federal government may manipulate interest rates, and so investment opportunities may be altered. Investment in education may itself affect the future rate of return, for example, by altering the income distribution, a variable on which the rate of interest depends.

Investment Criteria. A variety of investment criteria is available to the education decision-maker. There is no single one which is theoretically or practically correct for all investment situations, although several of them are conceptually equivalent if, but only if, (a) capital markets are perfectly competitive, (b) all available projects are completely divisible, (c) there is no interdependency among projects, and (d) all net returns can be reinvested at their own internal rates of return up to the terminal date of the longest lived project. The problem is now to select the criterion which fits the specific circumstances of this study. However, regardless of the particular criterion used, the fundamental goal of rational economic analysis is to maximize the present value of net benefits.

According to the net expected present value criterion, that project should be adopted for which the present value of the discounted stream of net benefits is greater than zero, given the appropriate interest rate. The advantage of this is that all costs need not occur in the beginning of the period, and different values for the interest rate used in discounting can be inserted if conditions are expected to change. However, if different interest rates are used to evaluate a set of projects with dissimilar time-benefit streams, different rankings may occur for each interest rate, and it will be unclear as to which ranking is the correct one. The present value rule may also prove to be invalid when a budget constraint or investment discontinuity faces the decision-maker.

The benefit-cost ratio is a variation on the present value criterion; it tells the decision-maker to invest in those projects for which the ratio of the present value of benefits to the present value of costs is greater than or equal to unity.

The internal rate of return is that interest rate which makes the discounted value of costs equal to the discounted value of benefits. It breaks down as a correct criterion if the projects are mutually exclusive, which may be the case from an individual point of view with educational or occupational investment in human beings. The most fundamental conceptual failure of the rate of return rule is that the single computed rate of return becomes conceptually irrelevant when the market interest rate varies over the life of the project, since all time periods are treated on a par.

In summary, when there is capital rationing, and this is probably a common situation for an individual contemplating investment in himself, the benefit-cost ratio is the proper criterion for investment decision-making. When there is no budget constraint, and for society (although not for governmental units) this is usually the case, adopting those projects with the maximum present value is the proper course of action.

C. Statistical Analysis

Statistical Analysis of Costs. The senior high schools in Cities A and C are now analyzed with a view to illustrate the procedure for resource allocation as well as to provide empirical evidence for statistical inference. Thus, the marginal cost of instructing an additional student and the optimal scale of operation of a senior high school can be obtained. The study concentrates mainly on an analysis of current costs because of data limitations. It is assumed that the only factor affecting the current costs of school operations is the quantity of output. Average daily attendance (ADA) is introduced as the explanatory output variable for the cost function. ADA^2 is introduced to account for the non-linear nature of the cost function. It is assumed that teachers' salaries and class size are proxy variables for quality.

The statistical analysis of costs indicates that marginal current costs of the vocational-technical senior high school curricula in Cities A and C are higher than the respective costs for the nonvocational-technical senior high school curricula of these two cities. The marginal cost differences range from about 100 to 200 dollars depending upon the assumptions used.

The optimal scale of operation is the level of output (ADA) at which average cost is at a minimum. If the statistical results derived in this study are reliable, the optimal scale of size of a nonvocational-technical senior high school is about 3,000 students although the actual range in ADA is from under 1000 to over 4000. The optimal scale of size of a vocational-technical senior high school is essentially indeterminate, given the small number of observations in this study. Given that the estimated average cost function for the nonvocational-technical senior high school reveals the optimum level of operation, many of the senior high schools in the sample are not operating at their most efficient point. However, it should also be indicated that the estimated average cost functions themselves may not reflect the most efficient methods for the production of education.

Statistical Analysis of Benefits. In order to compute or to attribute the net effect of the graduates' curricula on their labor market performance, it is necessary to control for intervening socio-demographic characteristics by the use of multiple regression analysis.

The use of the percentage of time employed as the dependent variable gives an explicit measurement of employment as a policy goal of education, while the use of earnings as a variable gives an explicit measurement of the major monetary benefits of education. However, both are only indices of benefit. The independent variables were described above in the section on benefit data. Each is expressed in terms of a dummy variable except for IQ and father's education. Interdependence among these independent variables may obscure the true nature of the empirical relationships which exist for each of the variables. So two steps are taken. First, the regression equation is estimated including all 1,255 observations. Second, regression equations are estimated which separate males and females and whites and nonwhites.

When considering the overall regression, and in particular, earnings before tax, nonvocational-technical graduates earned less than vocational-technical graduates during the first year after graduation. By the sixth year, however, the magnitude of the differences in earnings among curricula is not statistically different from zero. Over the long run the graduate's performance in the labor market is highly related to his labor market experience and socio-demographic characteristics rather than to the kind of training received in the relatively distant past. Nevertheless over the six years, given that both sets of graduates have the same socio-demographic backgrounds, vocational-technical graduates earned $3,456 more than graduates of the nonvocational-technical curriculum (specifically the academic curriculum). Similarly over the six years, vocational-technical graduates were employed 4.3 months more than graduates of the nonvocational-technical curriculum (specifically the academic curriculum).

Thus, given that earnings and employment are appropriate indices of the benefit of education, the analysis indicates that, for the study sample, vocational-technical graduates earned significantly more and were employed significantly longer than the graduates of the other four curricula over the six-year post-graduation period.

The sex variable has affected the levels of earnings and employment. In order to overcome this phenomenon, equations were estimated separately for males and females. While the married male graduate earned more than his unmarried counterpart, the opposite was true of females. There was similar concern about the interaction between race and other socio-economic variables. Nonwhite male graduates have neither as much advantage as white male graduates over their respective female counterpart in the labor market nor do employment opportunities for nonwhites vary according to curriculum.

Finally, twelve specialized groups of courses within the vocational-technical curriculum were analyzed in order to evaluate the differences among them in labor market performance. Tool design had the highest statistically significant difference in earnings relative to the other courses while personal service was lowest for the six-year post-graduation period. However, there is no statistically significant difference among courses on the basis of employment.

Vocational-Technical Education as an Investment. It is possible to analyze vocational-technical education in terms of its value as an investment in the human agent, but subject to the following constraints. This investment analysis holds strictly only for the study sample of non-college attending high school graduates of Cities A and C. It assumes that the future will be identical to the past. It assumes that the sub-samples of vocational-technical and nonvocational-technical high school graduates are identical in every respect; that every student member of the total sample is indifferent between vocational-technical and nonvocational-technical senior high school curricula on non-economic grounds (there are no differential consumption benefits to be gained by a student in pursuing one curriculum rather than another); that neither of the two subsets of graduates intend to go to college (the option value of higher education is zero for both groups); and finally, that monetary benefits are all that matter. The restrictions apply whatever investment criterion is used.

Benefits, as measured, are most accurately to be considered as differences between the average performances of graduates of vocational-technical and nonvocational-technical senior high school curricula. Because of this, two measures are most correct; the ratio of the discounted marginal benefit difference to the discounted marginal cost difference, and Fisher's rate of return. Also computed, however, are the net present value, the benefit-cost ratio and the internal rate of return. Each one of these, separately, shows that additional public funds should be spent on vocational-technical students rather than students of nonvocational-technical senior high schools.

The above analysis is restricted to current costs for City A and C. Capital costs are available only for City A. When these are included in the analysis, all the criterion measures for City A decrease in size. However, for City A given that monetary measures of costs and benefits are an accepted index of total costs and benefits, all except one of the criteria above continue to indicate that, for this sample, investment in vocational-technical education is an economically efficient investment. Thus, the evidence suggests that, given this sample of graduates, funds should be shifted from the nonvocational-technical senior high school curricula to the vocational-technical senior high school curricula.

D. Related Issues

Vocational Education and the Dropout. It is asserted by some that further benefits accrue to vocational education by virtue of the fact that students who might normally have dropped out when following the nonvocational-technical program might become successful graduates within a vocational-technical program.

The more relevant issue in dropout prevention is perhaps assuring that choice exists among curricula to suit different personalities and talents.

Nevertheless, in order to test the former proposition, the experience of a vocational-technical graduate who would have dropped out in any other program should be compared against a student who drops out because he was forced into another curriculum which was intellectually and constitutionally inhospitable to him. However, in this study, the comparison can only be made for students of any curriculum who graduate, and those of the same curriculum who drop out.

The employment and earnings benefits of the dropouts are measured from the time when they would have graduated. However, the useable sample is small. Over the six-year period, vocational-technical dropouts are employed 11.6 months more than the nonvocational-technical dropouts. The difference in employment between nonvocational-technical graduates and dropouts is greater than the difference between vocational-technical graduates and dropouts. Thus, while nothing can be said about the dropout saving propensity of the vocational-technical curriculum, one may be able to assert that dropouts from this curriculum fare better in the market place than dropouts from other curricula. But, it may be that vocational-technical students drop out in response to perceived labor market opportunities and not because of a fundamental inability to successfully complete high school. Finally, the analysis is qualified because the graduate and dropout samples are drawn from two different populations and are therefore not strictly comparable. Ex post facto analysis based on this type of data will not allow one to determine which type of senior high school curricula, vocational-technical or nonvocational-technical, has the greatest salvage effect on potential dropouts.

Vocational Education and the Employer. Many consider that one of the major benefits of a vocational-technical school is the ability of these schools to rectify short-run shortages in needed skills. But this depends upon the type of shortage. Where the shortage is structural, so the supply of a given type of labor cannot be increased even by a rise in wage rates, the role of vocational education could be to increase the supply. However, where the shortage exists because the firms demanding a certain skill are unable or unwilling to pay a higher wage rate, then vocational education is not necessarily the most desirable way to rectify the shortage. A higher wage rate, even if it caused the closure of some economically inefficient firms, would automatically elicit a greater supply without imposing the additional cost of the vocational education.

Fifty employers were selected on a systematic basis in each of Cities A, B and C, 129 of which were interviewed. On-the-job training for employees from vocational-technical senior high schools was on the average 12.64 weeks shorter than for employees who had other types of senior high school training. For the firms in the sample which had any type of training program, vocational-technical training not only shortened the training program but also resulted in a higher wage rate while in training. In fact, for those firms where training occurred, during the training period it cost vocational-technical employees about $245 less to receive the necessary training, thus increasing the internal rate of return to vocational-technical training. However, the statistical significance of these training cost differentials is not known.

Non-monetary and Non-economic Benefits. For a sample of 674 high school graduates, if voting behavior is a measure of citizenship and social participation, then curriculum alone does not have any statistically significant impact on socialization. It could be that the aggregation of data obscures important interrelationships among variables, but on net, there is no statistically significant difference among curricula either for voting behavior in the 1966 primary elections, or in the 1964 Presidential election.

Another index of benefit is career satisfaction. Vocational-technical graduates have .28 fewer jobs that do not fit in at all with their career interests than do nonvocational-technical graduates. It is thus fairly clear that vocational-technical training has in part done what it set out to do: to prepare workers for employment in specific skill areas, so workers do in fact find employment in their areas of training.

A final source of bias in measuring benefits to vocational-technical education may lie in differential psychological and motivational characteristics among graduates of different curricula. However, if the measures chosen are suitable indices, it does not appear that the choice of curriculum itself has any relationship with motivation and aspiration.

Thus, the statistical evidence of this sample does not suggest that there are differential levels of non-monetary benefit between vocational-technical and other curricula. As a result, with no major differences in non-economic benefits as herein presented, the economic benefits as measured may represent a fairly close estimate of total monetary and non-economic benefit.

E. Implications: A Final Judgment

From the sample of this study, the evidence is clear. Vocational-technical education is an economically worthwhile investment for individuals and for society. But what of the limitations of this study? To what extent can one generalize based on the results of this analysis?

Considerable refinement is still needed with respect to the relationship between economic concepts and theory, and the institutional (human, political and social patterns of behavior) framework surrounding education. Educational institutions should begin to keep adequate cost records as well as other information which relates to the production of education. This requires the maintenance of historical data in consistent and meaningful classifications, to be kept at the school level, and, even at the curriculum and course level. A recommendation of this study is that efforts should be made to determine the degree to which various educational programs are being efficiently operated, independent of the question as to the optimum allocation of resources between alternative educational programs. This implies that the production and cost functions of various educational programs should be analyzed.

The ability to generalize is further limited by the specific nature of the study sample and the time and place from which it is drawn. But no one study is expected to be definitive. Other analyses using different samples and different assumptions but employing the same basic economic framework will need to be performed. If these further studies corroborate the findings here, then generalizations can be made on safer grounds. Thus far, it can only be provisionally asserted that, for two, and possibly all three, of the cities which participated in this study, more funds should be devoted to vocational-technical education relative to nonvocational-technical senior high school curricula.

It has already been asserted that there is little knowledge at present about the degree to which various educational programs are being efficiently operated. This study has indicated that further investment in vocational-technical education is worthwhile. It does not necessarily follow that all alternative investments are not more worthwhile.

Additional analysis of the cost and production functions could reveal otherwise. Likewise if this report had indicated that further investment in nonvocational-technical education is worthwhile, it does not follow that the alternative investment, that is vocational-technical education, would not be more worthwhile. Further studies are required to evaluate alternative programs of vocational or occupational education.

APPENDIX I: LABOR MARKET QUESTIONNAIRE USED TO MEASURE MONEY AND EMPLOYMENT BENEFITS OF SECONDARY EDUCATION

Copy of cover page of Labor Market Questionnaire. The spacing has been altered. The actual mail questionnaire had the format of a four inch by nine inch booklet.

THE RELATION OF HIGH SCHOOL EDUCATIONAL PROGRAMS TO JOB EXPERIENCE AND CAREER DEVELOPMENT

A study being conducted by The Pennsylvania State University in cooperation with your high school.

Copy of inside cover page of Labor Market Questionnaire. The spacing has been altered.

A. High School Experience.

1. Did you graduate from high school?

YES ( ) (IF YES) 1a. Did you attend a junior college or a four year college or university for any period of time? YES ( ) NO ( )

NO ( ) (IF NO) 1b. What grade did you complete? __________grade

1c. Why were you unable to graduate from high school? ____

B. Military Service Record.

1. Have you ever been on continuous active duty for three months or longer? YES ( ) NO ( )
2. If YES, please answer the following:
   a. When did you go on active duty? Month________________Year__________________
   b. When were you (or will you be) released? Month_____________Year______________

C. Post High School Training Programs.

Have you taken any educational or training programs since you left high school (whether you graduated or not)? Yes ( ) NO ( )

If YES, please answer the following for each educational or training program:

Copy of Page 1 of Labor Market Questionnaire. The spacing has been altered.

	First Training Program	Second Training Program	Third Training Program
1. What skill or job did the program train you for?			
2. Why did you take this program?			
3. When did you start and leave the program?	Start: Mo.__________Yr.______ Leave: Mo.__________Yr.______	Start: Mo.__________Yr.______ Leave: Mo.__________Yr.______	Start: Mo.__________Yr.______ Leave: Mo.__________Yr.______
4. Did you finish the program?	Yes ( ) No ( )	Yes ( ) No ( )	Yes ( ) No ( )
5. Did you take this training on your own or was it given to you by a company you worked for or in the Armed Forces?	On Your Own ( ) Company ( ) Armed Forces ( )	On Your Own ( ) Company ( ) Armed Forces ( )	On Your Own ( ) Company ( ) Armed Forces ( )

Copy of Page 2 of Labor Market Questionnaire. The spacing has been altered.

D. Post High School Work Experience.
Have you held a job for one month or longer at any time since you left high school? Yes ( ) No ( )
If YES, please answer in the columns below. If you held more than one job at the same time, just list them both.
Again, let us assure you that this is a statistical study and your answers will be held in the strictest confidence.
Now, starting with the job you now have or your most recent job and working backward to the first job you had after leaving high school:

	Current or Most Recent Job	Next Most Recent Job	Next Job	Next Job	Next Job	Next Job
1. What is (was) this job called?						
2. What are (were) your duties on this job? That is, what do (did) you make or do?						
3. What month and year did you start and leave this job?	Start: Mo.____Yr.____ Leave: Mo.____Yr.____	Start: Mo.____Yr.____ Leave: Mo.____Yr.____	Start: Mo.____Yr.____ Leave: Mo.____Yr.____	Start: Mo.____Yr.____ Leave: Mo.____Yr.____	Start: Mo.____Yr.____ Leave: Mo.____Yr.____	Start: Mo.____Yr.____ Leave: Mo.____Yr.____
4. How did you get this job?						
5. What is (was) your pay before taxes and deductions, now (or when you left this job)?	$________ hour/week/month (circle one)	$________ hour/week/month (circle one)	$________ hour/week/month (circle one)	$________ hour/week/month (circle one)	$________ hour/week/month (circle one)	$________ hour/week/month (circle one)
6. How many hours per week on the average do (did) you work on this job?	____hours	____hours	____hours	____hours	____hours	____hours
7. What does (did) the company you work (worked) for make or do?						

Copy of Page 3 of Labor Market Questionnaire. The spacing has been altered.

E. Job Mobility and Relation of Training to Job.
Again, have you ever held a job for one month or longer since leaving high school? Yes ( ) No ( )
If YES, for each job that you have held for one month or longer since you left high school, please answer the following questions:

	Current or Most Recent Job	Next Most Recent Job	Next Job	Next Job	Next Job	Next Job
1. Did the acceptance of this job require a change of residence?	Yes ( ) No ( )	Yes ( ) No ( )	Yes ( ) No ( )	Yes ( ) No ( )	Yes ( ) No ( )	Yes ( ) No ( )
2. If YES, to what city and state?	City________ State________	City________ State________	City________ State________	City________ State________	City________ State________	City________ State________
3. Is (was) this job related to the high school curriculum (vocational, academic, or general) which you took?	Highly related ( ) Only moderately related ( ) Unrelated ( )	Highly related ( ) Only moderately related ( ) Unrelated ( )	Highly related ( ) Only moderately related ( ) Unrelated ( )	Highly related ( ) Only moderately related ( ) Unrelated ( )	Highly related ( ) Only moderately related ( ) Unrelated ( )	Highly related ( ) Only moderately related ( ) Unrelated ( )
4. On the whole, does this job fit in well with your overall job and career interests?	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )	Fits in very well ( ) Fits in only moderately well ( ) Does not fit in at all ( )
5. Where have you learned the most about the skills of this particular job?	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )	High school shop or classes ( ) Apprentice program ( ) Formal or informal on-the-job training ( ) Elsewhere ( )

Copy of Page 4 of Labor Market Questionnaire. The spacing has been altered.

F. Periods When You Were Not Working.

Since you left high school, are there any periods when you were not working or did not have a job? Yes ( ) No ( )
If YES, please answer in the columns below.

	Current or Most Recent Unemployment	Next Most Recent Unemployment	Next Unemployment	Next Unemployment	Next Unemployment	Next Unemployment
1. When did this period of not working or not having a job begin and end?	Begin: Mo.____Yr.____ End: Mo.____Yr.____	Begin: Mo.____Yr.____ End: Mo.____Yr.____	Begin: Mo.____Yr.____ End: Mo.____Yr.____	Begin: Mo.____Yr.____ End: Mo.____Yr.____	Begin: Mo.____Yr.____ End: Mo.____Yr.____	Begin: Mo.____Yr.____ End: Mo.____Yr.____
2. Why was it that you were not working or did not have a job?						
3. How much, if any, unemployment compensation did you collect each week during this period of time when you were not working or did not have a job?	None ( ), or $_____/week	None ( ), or $_____/week	None ( ), or $_____/week	None ( ), or $_____/week	None ( ), or $_____/week	None ( ), or $_____/week
4. For how many weeks did you collect this?	_________weeks	_________weeks	_________weeks	_________weeks	_________weeks	_________weeks
5. Apart from unemployment compensation, was there any other type of public aid or assistance which you received during this period?	None ( ), or $_____/week for____weeks	None ( ), or $_____/week for____weeks	None ( ), or $_____/week for____weeks	None ( ), or $_____/week for____weeks	None ( ), or $_____/week for____weeks	None ( ), or $_____/week for____weeks

Copy of Page 5 of Labor Market Questionnaire. The spacing has been altered.

G. Classification Data.

1. When were you born? Month____________ Year_____
2. Where were you born? City________________ State________________
3. Are you:
   Male ( ) Female ( )
   White ( ) Nonwhite ( )
   Married ( ) Single ( ) Separated, Widowed, or Divorced ( )

4a. How many dependents do you now have, not counting yourself?_________

4b. If you have one or more dependents, what are the ages of each of these? First dependent, ____years; second, ____years; third, ____years; fourth, ____years; fifth, ____years; sixth, ____years.

5. What was your father's main occupation for the majority of your elementary and high school years?____________________

6. Did your father live with your family for the majority of your elementary and high school years? Yes ( ) No ( )

7. How many years of school did your father complete? _____years.

8. How many years of school did your mother complete? _____years.

9. Are you currently a member of any of the following clubs or organizations?

a. Labor Union	Yes ( )	No ( )
b. Church or Religious Organization	Yes ( )	No ( )
c. Veteran's Organization	Yes ( )	No ( )
d. Business or Service Organization (Kiwanis, Chamber of Commerce, etc.)	Yes ( )	No ( )
e. Fraternal Organization (Elks, Masons, etc.)	Yes ( )	No ( )
f. Sports or Athletic Group	Yes ( )	No ( )
g. Youth Groups (YMCA, Boy Scouts, etc.)	Yes ( )	No ( )
h. Other (specify)____________________	Yes ( )	No ( )

Copy of back page of Labor Market Questionnaire. The spacing has been altered.

H. General Information.

1. As you know, most candidates for Congress or Governor or other political offices are nominated in a party primary election. Did you vote in the 1966 primary elections held in your city? Yes ( ) No ( ) Not Eligible To Vote ( )
2. If Not Eligible To Vote, is it because you failed to register ( ), or were not legally eligible to register ( )?
3. Did you vote in the 1964 Presidential election? Yes ( ) No ( ) Not Eligible To Vote ( )
4. If Not Eligible To Vote, is it because you failed to register ( ), or were you not legally eligible to register ( )?
5. What monthly sum of money (before taxes and deductions) do you think is just barely enough for you and your dependents to live on? $________/month
6. What monthly sum of money (before taxes and deductions) do you think is enough for you and your dependents to be really well off? $________/month
7. By the time your career is well established, what monthly sum of money (before taxes and deductions) would you expect to be making? $________/month

THANK YOU

Please put the folder in the addressed postage paid envelope and mail.
Thank you for your cooperation.

Questions H-1 through H-4 in this questionnaire are adapted from the 1964 Presidential Election Study conducted by the Social Research Center at the University of Michigan.

Questions H-5 through H-7 are adapted from Muzafer Sherif and Carolyn W. Sherif, Reference Groups, (New York: Harper & Row, 1964), p. 209. By permission of the authors.

APPENDIX II: EMPLOYER QUESTIONNAIRE USED TO MEASURE BENEFITS OF VOCATIONAL-TECHNICAL EDUCATION TO EMPLOYERS

Copy of cover page of Employer Questionnaire.
The spacing has been altered.

Employer Questionnaire

Part of the Study Entitled

AN ANALYSIS OF THE COMPARATIVE COSTS
AND BENEFITS OF VOCATIONAL VERSUS
ACADEMIC HIGH SCHOOL EDUCATION

(A Study financed by the U.S. Office of Education)

NAME OF FIRM____

ADDRESS OF FIRM______________________________________

PHONE______________________INTERVIEW DATE____________

INTERVIEW TIME______________________TO______________

INTRODUCTION: The Pennsylvania State University is trying to find out how well the high schools are preparing young people for employment. We are interested in the average graduate. We are not interested in the high school student who goes on to college or the high school student who drops out of high school before he graduates. Specifically, we are interested in discovering what your experiences have been with the vocational-technical high school graduates as compared with high school graduates who do not have a vocational-technical background. [INTERVIEWER: A VOCATIONAL-TECHNICAL GRADUATE IS A HIGH SCHOOL GRADUATE WHO HAS HAD AT LEAST TWO YEARS (4 SEMESTERS OR 2 UNITS) OF INTENSIVE PREPARATION IN A GIVEN VOCATIONAL SKILL AREA SUCH AS MACHINIST, AUTOMOTIVE REPAIR, OR BUSINESS EDUCATION.]

1. In general, how well do you think high schools are preparing young people for employment?____________________________

   ____

   ____

   ____

2. Could you give me a list of the jobs for which you hire high school students who have recently graduated? [INTERVIEWER: RECORD THE EXACT JOB TITLE USED BY THE FIRM.]

   (1)______________________(2)______________________

   (3)______________________(4)______________________

   (5)______________________(6)______________________

   (7)______________________(8)______________________

   (9)______________________(10)_____________________

3. Do you hire young people who have not completed high school for any of these jobs?

Yes______(IF YES) Which jobs? (CIRCLE ONE) 1 2 3 4 5 6 7 8 9 10
No ______(IF NO) Is a high school diploma necessary for employment with your firm? Yes_____ No_____

4. Are there any general reasons why you usually hire young and inexperienced people for these jobs?______________________________

____

5. I'd like to ask you a series of questions about each of these jobs for which you hire young people. I would like to discuss each job separately. However, the questions for each job are the same. If your company practices regarding different jobs are the same, just say so and I will only ask the set of questions once. [INTERVIEWER: FILL OUT A JOB SHEET FOR EACH JOB LISTED UNDER QUESTION #2. AFTER COMPLETING A FORM FOR EACH JOB LISTED, CONTINUE THE INTERVIEW WITH QUESTION #6]

6. Please tell me if you use any of these sources to recruit workers.

	(CIRCLE ONE)	COMMENT
Private employment agencies	Yes, No	______________________
Public employment agencies	Yes, No	______________________
School placement services	Yes, No	______________________
Unions	Yes, No	______________________
Personal contacts, walk-ins, or gate applicants	Yes, No	______________________
Newspaper ads	Yes, No	______________________
Others (SPECIFY) ______________________		

Which of these hiring methods do you use the most to hire recent high school graduates? [INTERVIEWER: PUT AN "M" IN FRONT OF THE ONE INDICATED].

Which of these hiring methods do you use the least to hire recent high school graduates? [INTERVIEWER: PUT AN "L" IN FRONT OF THE ONE INDICATED].

7. Has anyone from the public high schools, such as a placement officer, teacher, or guidance counselor, ever tried to place newly graduating high school students with you as workers?

Yes______No______(IF NO, GO TO 8.) (IF YES) Did you hire the graduates?

Yes______How did they work out?________________________________

____

____

No ______Can you recall your specific reasons for not hiring them?

____

____

8. What types of jobs are you finding it most difficult to fill right now? [INTERVIEWER: RECORD THE EXACT JOB TITLE USED BY THE FIRM.]

(1)____________________________(2)____________________________

(3)____________________________(4)____________________________

(5)____________________________(6)____________________________

(7)____________________________(8)____________________________

(9)____________________________(10)___________________________

I would like to ask you a series of questions about each of these jobs which you are currently finding difficult to fill. I would like to discuss each job separately. However, the questions for each job are the same. If your company practices regarding these different jobs are the same, just say so and I will only ask the set of questions once. [INTERVIEWER: FILL OUT A JOB SHEET FOR EACH JOB LISTED UNDER QUESTION #8. AFTER COMPLETING A FORM FOR EACH JOB LISTED, CONTINUE THE INTERVIEW WITH QUESTION #9.]

9. Has anyone from the vocational-technical schools in this city ever talked with you to determine if the vocational-technical schools could serve your needs better? Yes______No______
(COMMENT)____

____

____

10. Given the occupational and skill needs of your firm, do you think that the vocational-technical graduates currently working for your firm have less______, the same______, or more______ occupational preparation than the high school graduates currently working for your firm who have had no vocational-technical training in high school?
(COMMENT)____

____

____

11. How many of your employees hired within the last twelve months, whether or not they are recent high school graduates, have had vocational-technical training at the high school level?________

12. Do you keep any records which enable you to distinguish the high school curriculum of each of the persons your firm hires?
Yes______No______
[INTERVIEWER: IF YES, GET A FACSIMILE COPY OF THIS RECORD AND INCLUDE IT WITH THE COMPLETED QUESTIONNAIRE. IF YES, GO TO QUESTION 13.]

13. What proportion does this represent of the total number of those hired within the last twelve months?_________%

14. Now, just some classification data:

i. Number of employees________,number of women_____,
number of non-white_______.

ii. Type of service performed or product produced by your
firm.____

iii. (IF A COMPANY) Does your company have an agreement
with a union? Yes________No________

[INTERVIEWER: IF YES, ASK FOR A COPY OF ONE OF THE MOST RECENT COLLECTIVE BARGAINING AGREEMENTS BETWEEN THE FIRM AND THE UNION.]

iv. Full name of respondent___________________________

v. Position in organization___________________________

QUESTION #5 JOB SHEET

5a. I's like to ask you about (INSERT JOB TITLE)____________________

5b. Is this a job for males_______,females_______, or both_______?

5c. What are the duties of this job?______________________________

____

____

5d. Do any formal skill requirements exist for this job, such as fulfillment of an apprenticeship period or graduation from a private or public trade or vocational-technical school?

Yes______No______

(IF YES) What are these?______________________________________

____

____

5e. Do you hire only a vocational-technical high school graduate for this job or is any high school graduate considered to be adequate?

Vocational-technical______, any high school graduate______.

5f. Are specific courses taken in high school important in qualifying workers for this job? Yes______No______

(IF YES) Which courses are important?_________________________

____

5g. Does your organization give any training for this job, such as formal non-on-the-job training, formal on-the-job training, or informal on-the-job training? Yes______No______

(IF YES) i. What type of training?_____________________________

____

ii. How long does the training last?__________________

______________________(days, weeks, months CIRCLE ONE)

iii. Is this training period shorter for the vocational-technical high school graduate than for other high school graduates? Yes______No______

iv. (IF YES) By how much is it shorter?____________ (days, weeks, months CIRCLE ONE)

5h. What is the wage rate paid during this training period? $______ (hour, week, month CIRCLE ONE)

5i. Does the wage rate paid during this training period differ from that paid to other newly hired employees who are not undergoing a training period?

Yes______(IF YES) What is the wage rate paid to the newly hired employees who are not undergoing a training period? $_______ (hour, week, month CIRCLE ONE)

No ______(IF NO) Why does it not differ?____________________

____

5j. Does the wage rate paid to the vocational-technical high school graduate during this training period differ from that paid to other high school graduates?

Yes______(IF YES) i. What is the wage rate paid to the other high school graduates? $__________ (hour, week, month CIRCLE ONE)

ii. What is the wage rate paid to the vocational-technical graduate? $_______ (hour, week, month CIRCLE ONE)

No ______(IF NO) Why does it not differ?________________

____

THE FOLLOWING QUESTIONS PERTAIN TO THE TIME PERIOD AFTER TRAINING OR PROBATION

5k. Do newly hired employees who have undergone such training receive a higher wage after the training than similar newly hired employees who have not had such training? Yes_____No_____

51. (IF YES) i. What is the wage rate of those newly hired employees after they have completed training?
$______(hour, week, month CIRCLE ONE)

ii. For what length of time do they receive this wage?__________
(days, weeks, months CIRCLE ONE)

iii. What is the wage rate of those newly hired employees who have not had training, after their probation is over? $______
(hour, week, month CIRCLE ONE)

iv. For what length of time do they receive this wage?______
(days, weeks, months CIRCLE ONE)

QUESTION #8 JOB SHEET

IF JOBS ARE MENTIONED UNDER QUESTION 8, FOR EACH JOB, ASK THE FOLLOWING:

8a. I'd like to ask you about (INSERT JOB TITLE)____________________.

8b. What are the duties of this job?________________________________

____

8c. Could students be trained while in high school to fill this particular job need for your firm? Yes_____No_____

8d. Would you prefer that students be trained for this job while in high school or would you prefer to train them yourself? Train in high school______, train by firm_____.

8e. (IF TRAIN BY FIRM)

i. How long does the training last?_______________(days, weeks, months CIRCLE ONE)

ii. What is the wage rate paid during training? $________ (hour, week, month CIRCLE ONE)

iii. Is this wage rate different from that paid to other newly hired employees in the same job area who are not undergoing training?

Yes_______No_______

iv. (IF YES) At the time they are originally hired what is the wage rate paid to those newly hired employees in this job area who are not undergoing training? $_______ (hour, week, month CIRCLE ONE)

8f. What is the wage paid to this job (REPEAT JOB TITLE UNDER 8a ABOVE) after the training or probationary period for this newly hired employee is over? $_______(hour, week, month CIRCLE ONE)

8g. For what length of time do they receive this wage? _____________ (days, weeks, months CIRCLE ONE)

8h. Once the training or probationary period is over, does this post-training or post-probationary wage differ from that paid to other newly hired employees in the same job area who did not undergo such training? Yes______No______

8i. (IF YES) What is the wage rate paid after the probationary period to those newly hired employees who did not undergo training? $________(hour, week, month CIRCLE ONE)

8j. For what length of time do they receive this wage? ____________ (days, weeks, months CIRCLE ONE)

APPENDIX III

SIMILARITIES AND DIFFERENCES BETWEEN CITY A, CITY B (OTIS), AND CITY C (SCAT) IQ TESTS

A. Design of Questions

1. In the SCAT test, Parts II and IV consist of mathematical problems (to be done in 20 and 25 minutes respectively). Parts I and III consist of completing sentences (15 minutes) and pairing words with related meanings (10 minutes).

Example:

Part I: We had worked hard all day so that by evening we were quite (   ).

A. small B. tired C. old

D. untrained E. intelligent

Part II: 5413
-4827

F. 586 G. 596 H. 696

J. 1586 K. none of these

Part III: Chilly

A. tired B. nice C. dry

D. cold E. sunny

Part IV: Four $10-bills are equal to how many $5-bills?

F. 20 G. 10 H. 8 J. 40

K. 2

2. The OTIS "Gamma" test is composed of questions entirely different from the SCAT test.

Example:

1) An automobile is most likely to have _____.

(1) a radio (2) a heater (3) a gasoline tank

(4) a spare tire (5) fenders

2) This $0^{\&}X$ is to this $\&^{X}0$ as this $*^{@}\#$ is to

this _____.

(11) $\#^{@}*$ (12) $*^{\#}@$ (13) $@^{*}\#$ (14) $@^{\#}*$

3) Which of the following words is most like love, anger, and hope?

(31) fear (32) smell (33) life

(34) think (35) do

3. The "City A" test is similar to OTIS.

Example:

1) Which one of the five things below is most like these three: boy, girl, child?

(1) baby (2) man (3) tree (4) woman

(5) desk

2) Choppy is to sea as rocky is to what?

(1) land (2) tide (3) depth

(4) stone (5) boat

B. Function of the Test

1. The SCAT test intends to measure the skills the student has learned ever since he first entered school.

   a. SCAT Quantitative - Measure the ability to perform operations with numbers and to solve mathematics problems stated in words. This ability is most important in such school courses as mathematics and science.

   b. SCAT Verbal - Measures the ability to understand sentences and give the meanings of words. This ability is most important in such school courses as English, foreign languages, and social studies (history, civics, etc.).

   c. SCAT Total - Combines the scores on SCAT Verbal and Quantitative to provide the single best measure of the general capacity to do work of the next higher level of schooling.

2. The OTIS test intends to measure mental ability--thinking power or the degree of maturity of the mind, and not acquired skills learned in school.

3. The design of the "City A" test indicates that it measures some of the skills the student has been developing ever since he first entered school. But the OTIS and "City A" tests are called mental ability tests and are similar (although not exactly the same).

C. Administration of Test

1. SCAT

   a. There are two time schedules:

      1) one testing session of 95 minutes.

      2) two testing sessions of 45-50 minutes each.

   b. Total testing time is 70 minutes.

   c. Questions about directions are permitted during the test.

   d. Time allowances are sufficient enough to permit all but the slowest students to finish each part.

2. OTIS

   a. The tests are self-administering. Part of the test is to see if the student can follow directions.

   b. The test is half an hour long. No questions of any kind are permitted during the test.

3. "City A"

   a. The test is half an hour long.

   b. The examiner should check that the directions are being followed correctly during the test.

D. Techniques of Conversion

1. The Formula

The study requires that the IQ scores of the students from three cities are comparable. In order for the IQ scores to be comparable the distribution of these scores for each city has to be the same. The test of whether the IQ scores of each city are normally distributed is the Chi-Square test.[1] If the hypothesis that the distribution is normal is accepted, the formula of conversion for a given IQ (say City A) to another distribution of IQ (say City B) is as follows:

$$X_i = \frac{X_{iA} - \overline{X}_A}{S_A} \cdot S_B + \overline{X}_B$$

where X_i is the adjusted IQ score, X_{iA} is the IQ score in the City A to be adjusted, $\overline{X}_A$ and $\overline{X}_B$ are the mean of IQ scores in Cities A and B, respectively, and S_A and S_B are the standard deviation of IQ scores in Cities A and B, respectively.

---

[1] Hogg and Craig, Introduction to Mathematical Statistics, 2nd ed. (New York: MacMillan Co.), 1965, pp. 299-305.

The OTIS and "City A" tests have standard conversion tables from raw scores to IQ. The chronological age in "City A" test goes from 11-0 to 17-5. In OTIS it goes from 11-0 to 17-6 and over. The SCAT does not have prepared conversion tables. These must be prepared.

2. Construction of Conversion Tables for SCAT

   i. On the back of the stencil of the same form as the answer sheets used is a table for changing raw scores to converted scores.

   ii. It converts the verbal number right, the quantitative number right and the total number right.

   iii. The converted scores represent a statistical derivation and are more meaningful, because with them scores from form to form of SCAT are comparable.

   iv. The converted scores are then translated into percentile ranks through the use of norms tables.

      1) The percentile rank is used to describe the relative standing of a student with respect to other students.

      2) A percentile rank is meaningful as it relates to a specific comparison group. Such a group is called a "norms group." The general characteristics of a norms group must be clearly specified in order for the percentile ranks derived from it to be useful.

      3) A norms table indicates the norms group, and in addition, for maximum usefulness, the time of testing.

      4) Two kinds of norms tables will be of use in interpreting SCAT scores: norms based on a large sample of students tested in the fall and presented by the publisher in the Manual for Interpreting Scores, and norms developed for local groups at local levels.

5) A 68% confidence interval is used in the percentile ranks.

6) In selecting an appropriate norms table for interpretation of a student's verbal, quantitative, and total scores, it is necessary to consider the scholastic groups of which he is a member (e.g.. if he is a college-bound senior or not) and the scholastic groups for which SCAT norms are available.

To convert from the SCAT converted scores to IQ's one must select the proper table of the Manual for Interpreting Scores (e.g., grade 10 is Table 17) to determine the corresponding total percentile bands. Because the percentiles are given in a band, one must use the middle point as an estimate of percentile rank. After one determines the percentile rank, one must go to Table 2 of Report No. 14 of the OTIS Quick-Scoring Mental Ability Tests, Beta or Gamma: Percentile ranks corresponding to deviation IQ's with mean of 100 and standard deviation of 12.

3. The OTIS Test and "City A" Test

   i. OTIS: The GAMMA test has a table for deriving IQ's directly from scores and chronological age. All that is needed is the score obtained and the age of the student (year and month) at the time the test was administered.

   ii. "City A": This test also has a table for deriving IQ's directly from scores and chronological age. It is Table 3 - Table for Finding Intelligence Quotients from Test Scores - Form A (Grades 7-10).

E. Potential Error or Change in Meaning Due to Score Conversion

1. OTIS IQ

   a. Account must be taken of the fact that the standard deviation of these OTIS IQ's is approximately 12 IQ points, a value which is lower than that for IQ's from most other widely-used intelligence tests. A given IQ on OTIS is, therefore, comparable to one somewhat farther from 100 on another test; that is, to a higher IQ for IQ's above 100 and to a lower IQ for IQ's below 100.

b. The meaning of an IQ is not indicated by its numerical value; rather, the significance is in the proportion of the total population having IQ's above the measured value. Since the standard deviation of IQ's obtained from the three OTIS tests is 12, in contrast to the 16 of certain other tests, an OTIS IQ of 124 is just as "high" in its meaning or significance as one of 132 on one of these other tests, for each is 2 standard deviations above the mean of 100. Likewise a 148 on a test with a standard deviation of 16 is comparable to one of 136 on OTIS; each is 3 standard deviations above the mean and in a normal distribution there is the same percentage of IQ's above these two numerically-different values on the two tests.

c. At the other extreme of the scale, a 70 on OTIS is as far below the mean (2.5 standard deviations) as a 60 on a test with a standard deviation of 16. Likewise, an OTIS IQ of 88 is comparable to one of 84 on the other test; both represent the same relative level of intelligence.

F. Meaning of the Final Conversion

1. Assuming a normal distribution of these OTIS IQ's with M = 100 and the standard deviation = 12:

The top one percent of the total unselected population is set off by an IQ of 129 or above. Even at the adult LA level (17-6) the OTIS S-A higher, the Beta, and the Gamma tests allow for IQ's above this value.

For ages up to 15-6 each of these three tests allows for IQ's above 136, whereas 136 has a percentile rank of 99.8 in the total population and, therefore, sets off the top one-fifth of the top one percent.

APPENDIX IV

A COMPARISON BETWEEN THE NONRESPONSE SAMPLE AND THE RESPONSE SAMPLE

The statistical analysis in the study is based on 1,255 mail questionnaires. The overall rate of response was approximately one-third of the selected sample. We will consider in this appendix the effect of a nonresponse bias on the findings of this study.

There are two questions which need to be answered. First, are there any significant differences in terms of the average IQ, the sex composition and the choice of curriculum between the nonresponse and response groups? Second, if there is a difference, what will be the effect on the findings of this study?

To answer the first question, we choose randomly a sample of 798 nonrespondents, and compare it with the sample of 1,255 respondents in terms of IQ, composition of males and females, and curriculum. A summary table follows:

A COMPARISON OF SAMPLE CHARACTERISTICS OF NONRESPONDENTS AND RESPONDENTS

Characteristics	NonRespondents		Respondents	
Average IQ	98.8	(30.5)	103.7	(11.0)
% of Male	49.4		25.7	
% of Academic Graduates	21.7		18.8	
% of Vocational-Academic Graduates	5.4		3.7	
% of Vocational-Technical Graduates	36.1		44.9	
% of Vocational-Comprehensive Graduates	22.9		22.9	
% of General Graduates	13.9		9.7	

The value in the parenthesis is the standard deviation. The above table suggests that the average IQ is lower for nonrespondents than for respondents. Furthermore, male graduates are more likely to ignore the questionnaire than female graduates. This is confirmed by the statistical test (two-tail at a 5 percent level). The assumption of no differences in IQ and sex composition between nonrespondents and respondents is not accepted. However, there is no significant differences between these two groups with respect to curriculum.

It is clear now that there are some differences in sample characteristics between nonrespondents and respondents. The question then is what will be the effect on the findings of this study. To answer this question, we have obtained 187 questionnaires by personal interview. These 187 graduates were chosen from the nonresponse mail questionnaire sample. Based on these personal interview questionnaires, we can compare the overall labor market performance between the nonrespondents and respondents. The differences can be tested in terms of regression coefficients in two regression equations.[1]

We use the same basic independent variables as in Table 26 of Chapter VIII to estimate average six-year period before-tax monthly earnings and employment equations, based on 187 personal interview sample observations. Results are shown in Table I of this Appendix. Furthermore we combined the 1,255 mail questionnaire observations and 187 personal interview observations to estimate average six-year before-tax monthly earnings and employment equations as shown in Table II of the Appendix. Based on the information in Tables 26 and 29 of Chapter VIII and the tables in this Appendix, we can obtain the error sums of square (SSE) for each equation. We can formulate an F-ratio to test the hypothesis that each partial regression coefficient in the equation estimated from mail questionnaires is equal to its respective counterpart in the equation estimated from the personal interview sample.

---

1. See J. Johnston, Econometric Methods, (New York: McGraw-Hill, 1963), pp. 136-138.

The formula for the F-ratio is as follows:

$$F = \frac{(SSE_T - SSE_Q - SSE_P)/k}{SSE_Q + SSE_P/n + m - 2k}$$

where SSE_T = error sums of square for the equation estimated from the pooled mail questionnaire and personal interview samples;

SSE_Q = error sums of square for the equation estimated from the mail questionnaire sample;

SSE_P = error sums of square for the equation estimated from the personal interview sample;

k = number of parameters in the equation;

n = number of observations in questionnaire sample; and,

m = number of observations in personal interview sample.

This F-ratio has for its degrees of freedom k and n + m - 2k. We will test the six-year average before-tax monthly earnings equation and employment equation, respectively. Based on the six-year average before-tax monthly earnings equation, we obtain

$$F = \frac{(28{,}652{,}067 - 23{,}107{,}724 - 4{,}703{,}901)/13}{(23{,}107{,}724 + 4{,}703{,}901)/(1255 + 187 - 2 \times 13)}$$

$$= 3.32$$

Based on the six-year employment equation, we obtain

$$F = \frac{(921{,}664 - 709{,}819 - 180{,}808)/13}{(709{,}819 + 180{,}808)/(1255 + 187 - 2 \times 13)}$$

$$= 3.83$$

At the 0.01 level of significance the F-value (with 13, and 1429 degrees of freedom) is 2.18. The computed F-ratio is greater than 2.18 in both equations, therefore we fail to accept the hypothesis that the partial regression coefficients from the two samples are equal.

Although these tests indicate that the mail questionnaire sample may not have come from the same population as the personal interview sample, we do not consider these tests to be against the validity of our empirical findings in the study. If we compare the mail questionnaire equation and the personal interview equation, we will find that each correspondent partial regression coefficient has the same direction of sign. Furthermore, the level of statistical significance is also compatible. This comparison assures us that the statistical findings in the study are still valid in spite of the differences in mail questionnaire sample and personal interview sample. However, this judgment is qualified by the fact that no information can be gained on those members of the sample who had no known address. We simply do not know what effect the addition of this group, could it be found, would have on the study results.

APPENDIX IV

Table I: Average Before Tax Monthly Earnings and Percent of Time Employed in Six-Year Period After High School Graduation, Cities A, B, and C, Personal Interview Sample, in Dollars and Percentage Points

Variable	Earnings b	Earnings (s)	Employment b	Employment (s)
Curriculum				
Academic@				
Vocational-Academic	34	(60)	2	(11)
Vocational-Comprehensive	90*	(38)	6	(7)
General	62	(50)	7	(10)
Vocational-Technical	114**	(34)	17**	(7)
Labor Market				
City A@				
City B	-12	(32)	-2	(6)
City C	2	(30)	0.15	(6)
Male	160**	(26)	16**	(5)
IQ	-1	(0.6)	-0.26*	(0.12)
White	91**	(30)	20**	(6)
Marital Status				
Married@				
Single	13	(28)	8	(5)
Widowed, Separated, Divorced	81	(120)	8	(23)
Father's Education	-2	(4)	0.14	(0.89)
Number of Observations	187		187	
Coefficient of Determination#	0.26		0.17	
Intercept	219	(83)	64	(16)
Standard Error of Estimate		164		32
Mean of Dependent Variable	292	(186)	69	(34)
F-Ratio:				
All Variables	5.33**		3.01**	
Curriculum	2.94**		2.01*	
Labor Market	0.10		0.05	
Marital Status	0.31		1.16	

APPENDIX IV

Table 1--Continued

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

APPENDIX IV

Table II: Average Before Tax Monthly Earnings and Percent of Time Employed in Six-Year Period After High School Graduation, Cities A, B, C, Including Mail Questionnaire and Personal Interview Samples, in Dollars and Percentage Points

Variable	Earnings		Employment	
	b	(s)	b	(s)
Curriculum				
Academic@				
Vocational-Academic	45*	(21)	8*	(4)
Vocational-Comprehensive	45**	(12)	5**	(2)
General	22	(15)	3	(2)
Vocational-Technical	55**	(11)	9**	(2)
Labor Market				
City A@				
City B	-7	(9)	-3	(2)
City C	0.11	(9.58)	-6**	(1)
Male	187**	(8)	17**	(1)
IQ	0.39	(0.29)	-0.00	(0.05)
White	71**	(11)	9**	(2)
Marital Status				
Married@				
Single	42**	(9)	14.2**	(1)
Widowed, Separated, Divorced	11	(41)	-0.83	(7.38)
Father's Education	-0.04	(1.31)	-0.11	(0.23)
Number of Observations	1442		1442	
Coefficient of Determination#	0.28		0.16	
Intercept	99	(34)	58	(6)
Standard Error of Estimate		141		25
Mean of Dependent Variable	298	(167)	76	(27)
F-Ratio:				
All Variables	48.50**		23.39**	
Curriculum	7.22**		6.47**	
Labor Market	0.29		6.41**	
Marital Status	11.08**		38.02**	

APPENDIX IV

Table II--Continued

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other dummy regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

APPENDIX V

TABLE I

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY A, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	29	(36)	49	(34)	39	(50)
Vocational-Comprehensive	20	(16)	82**	(16)	3	(22)
General	1	(22)	50*	(21)	-21	(30)
Vocational-Technical	40*	(17)	88**	(16)	34	(24)
Male	196**	(12)	84**	(12)	311**	(17)
IQ	1.86**	(0.46)	1.34**	(0.45)	2.53**	(0.65)
White	57**	(15)	98**	(15)	8	(21)
Marital Status						
Married[@]						
Single	49**	(12)	-1	(12)	137**	(17)
Separated, Widowed, Divorced	19	(54)	-25	(52)	88	(76)
Father's Education	1.57	(1.83)	0.88	(1.78)	0.69	(2.57)
Number of Observations	648		648		648	
Coefficient of Determination[#]	0.32		0.17		0.39	
Intercept	-44	(56)	-57	(54)	-112	(78)
Standard Error of Estimate	131		127		184	
Mean of Dependent Variable	298	(169)	264	(140)	287	(236)
F-Ratio:						
All Variables	32.28**		14.33**		42.89**	
Curriculum	2.11*		8.55**		1.81*	
Marital Status	7.93**		0.11		32.41**	

Notes:

* Significant at the .05 level.

** Significant at the .01 level.

b is the partial regression coefficient.

(s) is the standard error of the partial regression coefficient.

@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.

# Adjusted for degrees of freedom.

TABLE II

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY B, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic†						
Vocational-Comprehensive	54*	(26)	22	(25)	44	(32)
General	84*	(33)	42	(31)	92*	(41)
Vocational-Technical	48**	(19)	31	(18)	75**	(23)
Male	184**	(18)	81**	(17)	309**	(22)
IQ	1.48*	(0.73)	0.34	(0.69)	2.52**	(0.89)
White	66*	(26)	136**	(24)	-45	(32)
Marital Status						
Married@						
Single	33	(20)	-22	(19)	82**	(25)
Separated, Widowed, Divorced	-45	(71)	-89	(67)	-73	(86)
Father's Education	-0.58	(2.86)	0.36	(2.69)	0.11	(3.48)
Number of Observations	314		314		314	
Coefficient of Determination#	0.31		0.18		0.45	
Intercept	-4	(80)	62	(75)	-82	(97)
Standard Error of Estimate	140		132		170	
Mean of Dependent Variable	305	(169)	263	(146)	306	(229)
F-Ratio:						
All Variables	17.11**		8.66**		29.19**	
Curriculum	4.34**		0.83		1.87*	
Marital Status	1.57		1.43		5.87**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
†	There is no vocational-academic curriculum in City B.
#	Adjusted for degrees of freedom.

TABLE III

AVERAGE BEFORE TAX MONTHLY EARNINGS EXPERIENCE OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	81*	(34)	64*	(33)	78*	(50)
Vocational-Comprehensive	54	(44)	23	(42)	25	(63)
General	-4	(34)	15	(33)	-3	(50)
Vocational-Technical	60**	(24)	66**	(23)	66*	(35)
Male	225**	(22)	61**	(22)	399**	(33)
IQ	0.29	(0.83)	1.20	(0.80)	-1	(1.20)
White	71*	(32)	87*	(31)	21	(47)
Marital Status						
Married@						
Single	70**	(22)	20	(21)	124	(31)
Separated, Widowed, Divorced†						
Father's Education	-1.66	(2.92)	-3.37	(2.81)	-0.67	(4.23)
Number of Observations	293		293		293	
Coefficient of Determination#	0.28		0.06		0.36	
Intercept	117	(91)	10	(88)	261*	(132)
Standard Error of Estimate	144		138		208	
Mean of Dependent Variable	299	(169)	237	(142)	316	(262)
F-Ratio:						
All Variables	13.61**		3.13**		20.06**	
Curriculum	2.83**		2.59**		1.48	
Marital Status	10.58**		0.89		15.82**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
† This regressor of the variable is not represented in City C.
# Adjusted for degrees of freedom.

TABLE IV

PERCENT OF TIME EMPLOYED OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY A, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	4.1	(6.3)	5.5	(7.1)	5.6	(10.4)
Vocational-Comprehensive	4.2	(2.9)	17.0**	(3.3)	-0.2	(4.8)
General	3.8	(3.8)	11.6**	(4.3)	-3.4	(6.3)
Vocational-Technical	7.8*	(3.0)	19.6**	(3.4)	6.2	(4.9)
Male	18.8**	(2.2)	2.7	(2.5)	38.2**	(3.6)
IQ	0.18*	(0.08)	0.18*	(0.09)	0.25*	(0.13)
White	6.3**	(2.7)	19.7**	(3.0)	-7.3	(4.4)
Marital Status						
Married@						
Single	14.4**	(2.2)	-1.2	(2.4)	37.0**	(3.6)
Separated, Widowed, Divorced	-0.9	(9.6)	-25.9*	(10.8)	23.7	(15.8)
Father's Education	0.02	(0.32)	-0.24	(0.36)	0.09	(0.53)
Number of Observations	648		648		648	
Coefficient of Determination#	0.17		0.12		0.26	
Intercept	40.9	(9.9)	34.2	(11.2)	24.7	(16.2)
Standard Error of Estimate	23.3		26.3		38.3	
Mean of Dependent Variable	79.4	(25.6)	83.1	(28.0)	66.6	(44.8)
F-Ratio:						
All Variables	14.14**		9.61**		24.75**	
Curriculum	1.79		9.55**		1.25	
Marital Status	21.91**		2.95**		54.50**	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE V

PERCENT OF TIME EMPLOYED OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY B, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic[†]						
Vocational-Comprehensive	9.7*	(4.3)	10.8*	(5.13)	7.4	(6.89)
General	11.7*	(5.5)	10.9	(6.55)	11.1	(8.4)
Vocational-Technical	10.3**	(3.2)	12.5*	(3.76)	16.3**	(5.0)
Male	20.6**	(3.0)	0.5	(3.63)	44.4**	(4.8)
IQ	0.21	(0.12)	-0.02	(0.14)	0.41*	(0.19)
White	-1.4	(4.3)	24.2**	(5.12)	-27.4	(6.8)
Marital Status						
Married[@]						
Single	12.8**	(3.4)	-8.5*	(4.04)	27.6**	(5.4)
Separated, Widowed, Divorced	-7.7	(11.7)	-27.1*	(13.95)	-12.0	(18.5)
Father's Education	0.06	(0.47)	-0.28	(0.56)	0.02	(0.74)
Number of Observations	314		314		314	
Coefficient of Determination[#]	0.19		0.12		0.32	
Intercept	39.9	(13.1)	58.1	(15.6)	20.6	(20.7)
Standard Error of Estimate	23.0		27.5		36.4	
Mean of Dependent Variable	78.2	(25.7)	80.8	(29.4)	69.5	(44.4)
F-Ratio:						
All Variables	9.37**		5.83**		17.91**	
Curriculum	5.07**		4.40**		1.19	
Marital Status	7.56**		3.85**		13.75**	

Notes:

- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- † There is no vocational-academic curriculum in City B.
- # Adjusted for degrees of freedom.

TABLE VI

PERCENT OF TIME EMPLOYED OF NON-COLLEGE SENIOR HIGH SCHOOL GRADUATES, CITY C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	12.2*	(6.3)	10.7	(7.9)	15.4	(9.5)
Vocational-Comprehensive	-0.9	(8.0)	-0.5	(10.0)	-1.4	(12.0)
General	-7.2	(6.2)	-0.8	(7.9)	-4.0	(9.4)
Vocational-Technical	5.4	(4.4)	7.2	(5.5)	10.4*	(6.6)
Male	22.4**	(4.1)	3.8	(5.2)	44.1**	(6.3)
IQ	0.06	(0.15)	0.25	(0.19)	-0.33	(0.22)
White	14.5**	(5.9)	23.8**	(7.4)	-3.0	(8.9)
Marital Status						
Married@						
Single	19.4**	(3.9)	-2.5	(4.9)	34.7**	(5.9)
Separated, Widowed, Divorced†						
Father's Education	-0.65	(0.53)	-1.25*	(0.67)	-0.16	(0.80)
Number of Observations	293		293		293	
Coefficient of Determination#	0.17		0.03		0.23	
Intercept	61.9	(16.6)	32.7	(20.9)	81.5	(25.0)
Standard Error of Estimate	26.0		32.9		39.4	
Mean of Dependent Variable	74.1	(28.5)	73.7	(33.5)	65.1	(45.0)
F-Ratio:						
All Variables	7.43*		2.15*		10.96**	
Curriculum	2.37*		0.92		1.60	
Marital Status	24.74*		0.25		34.58**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
†	This regressor of the variable is not represented in City C.
#	Adjusted for degrees of freedom.

TABLE VII

TRAINING RELATEDNESS OF EARNINGS AND EMPLOYMENT FIRST YEAR AFTER GRADUATION OF SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Earnings		Employment	
	b	(s)	b	(s)
Curriculum				
Academic@				
Vocational-Academic	39*	(21)	8.2*	(4.6)
Vocational-Comprehensive	38**	(12)	9.0**	(2.7)
General	20	(15)	5.5	(3.26)
Vocational-Technical	44**	(11)	10.8**	(2.4)
Labor Market				
City A@				
City B	-5	(9)	-2.0	(2.0)
City C	-28**	(10)	-10.5**	(2.1)
Male	93**	(9)	4.4*	(1.9)
IQ	0.94**	(0.34)	0.11	(0.07)
White	92**	(12)	18.9**	(2.5)
Marital Status				
Married@				
Single	-9	(9)	-3.2	(1.9)
Separated, Widowed, Divorced	-41	(41)	-24.4*	(8.9)
Father's Education	0.12	(1.28)	-0.42	(0.28)
Training Relatedness	54**	(9)	10.1**	(1.9)
Number of Observations	1,255		1,255	
Coefficient of Determination#	0.18		0.14	
Intercept	-5	(39)	44.2	(8.4)
Standard Error of Estimate	129		28.0	
Mean of Dependent Variable	258	(142)	80.3	(29.9)
F-Ratio:				
All Variables	21.60**		15.21**	
Curriculum	4.48**		5.55**	
Labor Market	4.20		12.72**	
Marital Status	0.97		4.98**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

TABLE VIII

NUMBER OF TRAINING RELATED JOBS HELD IN RELATION TO EARNINGS AND EMPLOYMENT DURING THE SIX-YEAR PERIOD AFTER GRADUATION, CITIES A, B, AND C, IN DOLLARS AND PERCENTAGE POINTS

Variable	Earnings		Employment	
	b	(s)	b	(s)
Curriculum				
Academic@				
Vocational-Academic	52*	(23)	8.8*	(3.9)
Vocational-Comprehensive	34**	(13)	3.4	(2.2)
General	16	(16)	2.0	(2.7)
Vocational-Technical	46**	(11)	6.1**	(2.0)
Labor Market				
City A@				
City B	-3	(10)	-1.8	(1.7)
City C	9	(10)	-4.7**	(1.8)
Male	201**	(9)	20.3**	(1.6)
IQ	1.46**	(0.36)	0.12*	(0.06)
White	61**	(12)	5.8**	(2.1)
Marital Status				
Married@				
Single	50**	(9)	15.5**	(1.6)
Separated, Widowed, Divorced	-2	(44)	-0.8	(7.6)
Father's Education	0.12	(1.35)	-0.12	(0.24)
Number of Training Related Jobs Held	2.72	(3.30)	2.41**	(0.57)
Number of Observations	1,255		1,255	
Coefficient of Determination#	0.32		0.20	
Intercept	-6	(61)	46.5	(7.1)
Standard Error of Estimate	136		23.8	
Mean of Dependent Variable	300	(164)	77.9	(26.4)
F-Ratio:				
All Variables	44.61**		23.44**	
Curriculum	4.77**		3.10**	
Labor Market	0.57		3.51**	
Marital Status	14.08**		44.42**	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- # Adjusted for degrees of freedom.

TABLE IX

AVERAGE BEFORE TAX MONTHLY EARNINGS OF SENIOR HIGH SCHOOL GRADUATES RELATING TO ON-THE-JOB TRAINING, CITIES A, B, AND C, IN DOLLARS

Variable	First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)
Curriculum				
Academic@				
Vocational-Academic	47*	(21)	53	(31)
Vocational-Comprehensive	50**	(12)	29	(17)
General	28*	(15)	17	(21)
Vocational-Technical	55**	(11)	59**	(15)
Labor Market				
City A@				
City B	-2	(9)	1	(14)
City C	-24**	(10)	43**	(14)
Male	87**	(9)	324**	(12)
IQ	1.04**	(0.33)	1.84**	(0.48)
White	100**	(12)	2	(17)
Marital Status				
Married@				
Single	-6	(9)	120**	(13)
Separated, Widowed, Divorced	-47	(41)	25	(60)
Father's Education	0.16	(1.28)	-0.43	(1.85)
On-the-Job Training	-44**	(8.04)	33**	(12)
Number of Observations	1,255		1,255	
Coefficient of Determination#	0.17		0.40	
Intercept	18	(39)	-58	(56)
Standard Error of Estimate	130		187	
Mean of Dependent Variable	258	(142)	299	(241)
F-Ratio:				
All Variables	20.90**		64.42**	
Curriculum	7.59**		4.46**	
Labor Market	3.19**		5.23**	
Marital Status	0.81		42.68**	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE X

PERCENT OF TIME EMPLOYED OF SENIOR HIGH SCHOOL GRADUATES RELATING TO ON-THE-JOB TRAINING, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)
Curriculum				
Academic[@]				
Vocational-Academic	9.3*	(4.58)	12.02	(6.8)
Vocational-Comprehensive	10.6**	(2.56)	4.2	(3.5)
General	6.8*	(3.17)	1.5	(4.4)
Vocational-Technical	12.2**	(2.25)	10.9**	(3.1)
Labor Market				
City A[@]				
City B	-1.7	(2.00)	1.4	(2.8)
City C	-9.4**	(2.09)	0.7	(2.9)
Male	3.8	(1.87)	40.1**	(2.6)
IQ	0.12	(0.07)	0.18*	(0.09)
White	20.1**	(2.48)	-10.5**	(3.4)
Marital Status				
Married[@]				
Single	-2.3	(1.92)	34.6**	(2.6)
Separated, Widowed, Divorced	-25.1**	(8.82)	10.3	(12.1)
Father's Education	-0.35	(0.27)	-0.06	(0.37)
On-the-Job Training	-12.4**	(1.72)	4.8*	(2.4)
Number of Observations	1,255		1,255	
Coefficient of Determination#	0.15		0.28	
Intercept	50.6	(8.3)	31.6	(11.4)
Standard Error of Estimate	27.7		38.1	
Mean of Dependent Variable	80.3	(29.9)	67.0	(44.7)
F-Ratio:				
All Variables	17.27**		37.57**	
Curriculum	7.86**		4.21**	
Labor Market	10.38**		0.13	
Marital Status	4.66**		85.30**	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE XI

RELATIONS OF TRAINING TO EMPLOYMENT AFTER GRADUATION FOR SENIOR HIGH SCHOOL GRADUATES, CITIES A, B, AND C

Variable	Total Number of Jobs Held in the Six Year Period After Graduation		Training Relatedness of First Job After Graduation		Total Number of Training Related Jobs Held in the Six Year Period After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	.05	(.20)	.24**	(.07)	.49*	(.19)
Vocational-Comprehensive	-.03	(.11)	.37**	(.04)	.76**	(.11)
General	.24	(.14)	.20**	(.05)	.50**	(.13)
Vocational-Technical	.03	(.10)	.35**	(.03)	.76**	(.09)
Labor Market						
City A@						
City B	-.05	(.09)	.10**	(.03)	.13	(.08)
City C	.01	(.09)	.0	(.03)	.08	(.09)
Male	.46**	(.08)	-.23**	(.03)	-.25**	(.08)
IQ	.009*	(.003)	.004**	(.001)	.011**	(.003)
White	-.41**	(.11)	.23**	(.04)	.0	(.11)
Marital Status						
Married@						
Single	.13	(.08)	.02	(.03)	-.01	(.08)
Separated, Widowed, Divorced	-.57	(.38)	-.18	(.13)	-.86**	(.37)
Father's Education	-.01	(.01)	-.01*	(.01)	-.02	(.01)
Number of Observations	1,255		1,255		1,255	
Coefficient of Determination#	.04		.17		.07	
Standard Error of Estimate	1.20		0.42		1.17	
Intercept	1.57	(.38)	-0.02	(.13)	-0.08	(.37)
Mean of Dependent Variable	2.19	(1.22)	0.70	(.46)	1.50	(1.21)
F-Ratio:						
All Variables	5.13**		22.29**		8.78**	
Curriculum	1.05		31.63**		18.23**	
Labor Market	.24		6.91**		1.23	
Marital Status	2.42**		1.04		2.64**	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
#	Adjusted for degrees of freedom.

TABLE XII

VOLUNTARY NOT-IN-LABOR FORCE EXPERIENCE OF SENIOR HIGH SCHOOL GRADUATES FOR SELECTED TIME PERIODS AFTER END OF SCHOOLING, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	-12.4**	(4.7)	-5.6	(5.6)	-15.8*	(7.6)
Vocational-Comprehensive	-2.8	(2.5)	-4.9	(3.1)	-1.2	(4.1)
General	0.7	(2.9)	-4.6	(3.5)	-1.4	(4.7)
Vocational-Technical	-4.1	(2.2)	-8.0**	(2.6)	-5.2	(3.5)
Labor Market						
City A[@]						
City B	1.5	(1.9)	4.4	(2.3)	-0.3	(3.1)
City C	5.0	(2.0)	9.6**	(2.4)	0.8	(3.2)
Male	-15.8**	(1.6)	-3.2	(2.0)	-30.7	(2.7)
IQ	-0.02	(0.07)	-0.02	(0.09)	-0.14	(0.12)
White	-5.8**	(2.2)	-17.7**	(2.6)	9.4**	(3.5)
Marital Status						
Married[@]						
Single	-12.6**	(1.7)	-0.05	(2.1)	-25.1**	(2.8)
Separated, Widowed, Divorced	-2.4	(3.0)	-0.4	(3.6)	-11.2	(4.9)
Father's Education	0.21	(.25)	0.52	(0.31)	-0.10	(0.42)
Number of Observations[†]	678		678		678	
Coefficient of Determination[#]	0.19		0.10		0.23	
Intercept	27.2	(8.3)	24.3	(10.0)	47.2	(13.4)
Standard Error of Estimate	19.4		23.4		31.4	
Mean of Dependent Variable	11.6	(21.5)	8.7	(24.6)	17.0	(35.8)
F-Ratio:						
All Variables	14.45**		6.92**		17.95**	
Curriculum	2.80*		2.41*		1.59	
Labor Market	3.23*		7.93**		0.05	
Marital Status	0.66		1.36		2.67	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- † The number of observations is less than 1,255 due to the lack of information on the voluntary not-in-labor force experience.
- # Adjusted for degrees of freedom.

TABLE XIII

AVERAGE BEFORE TAX MONTHLY EARNINGS OF SENIOR HIGH SCHOOL GRADUATES, EXCLUDING NOT-IN-LABOR FORCE: FEMALE OBSERVATIONS, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic[@]						
Vocational-Academic	43	(23)	31	(27)	22	(20)
Vocational-Comprehensive	15	(14)	36	(17)	1	(18)
General	-8	(21)	-5	(25)	7	(27)
Vocational-Technical	31**	(13)	51	(15)	34*	(17)
Labor Market						
City A[@]						
City B	-1	(12)	-4	(14)	8	(15)
City C	16	(12)	-25	(14)	40**	(15)
IQ	1.61**	(0.40)	0.85*	(0.46)	2.17**	(0.51)
White	76	(12)	113	(14)	28	(15)
Marital Status						
Married[@]						
Single	27**	(9)	-11	(11)	57**	(12)
Separated, Widowed, Divorced	31	(52)	-4	(60)	74	(66)
Father's Education	1.11	(1.55)	0.89	(1.81)	-0.37	(1.98)
Number of Observations	562		562		562	
Coefficient of Determination[#]	0.15		0.15		0.10	
Intercept	37	(46)	33	(54)	51	(59)
Standard Error of Estimate	102		119		131	
Mean of Dependent Variable	313	(110)	248	(129)	348	(137)
F-Ratio:						
All Variables	8.99**		9.36**		5.72**	
Curriculum	2.41**		3.81**		1.71	
Labor Market	1.17		1.70		3.65**	
Marital Status	4.18**		0.53		11.81**	

Notes:
* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE XIV

PERCENT OF TIME EMPLOYED OF SENIOR HIGH SCHOOL GRADUATES, EXCLUDING NOT-IN-LABOR FORCE: FEMALE OBSERVATIONS, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After Graduation		Sixth Year After Graduation	
	b	(s)	b	(s)	b	(s)
Curriculum						
Academic@						
Vocational-Academic	8.0*	(4.0)	8.6	(6.4)	1.7	(5.3)
Vocational-Comprehensive	4.0	(2.5)	10.6*	(4.0)	3.9	(3.3)
General	-0.8	(3.7)	1.5	(5.9)	-0.8	(4.9)
Vocational-Technical	5.3*	(2.3)	11.5*	(3.6)	6.8*	(3.0)
Labor Market						
City A@						
City B	-1.5	(2.0)	-4.6	(3.2)	2.3	(2.7)
City C	-4.4*	(2.0)	-13.5**	(3.2)	-1.3	(2.6)
IQ	0.07	(0.06)	0.06	(0.11)	0.11	(0.09)
White	13.8**	(2.1)	25.8**	(3.3)	1.3	(2.7)
Marital Status						
Married@						
Single	4.8**	(1.6)	-5.0	(2.6)	10.9**	(2.1)
Separated, Widowed, Divorced	0.9	(8.9)	-22.6	(14.4)	15.8	(11.8)
Father's Education	-0.31	(0.26)	-0.43	(0.42)	-0.43	(0.35)
Number of Observations	562		562		562	
Coefficient of Determination#	0.10		0.15		0.06	
Intercept	68.0	(7.9)	54.0	(12.7)	73.5	(10.5)
Standard Error of Estimate	17.6		28.3		23.3	
Mean of Dependent Variable	87.9	(18.5)	79.8	(30.6)	90.2	(23.9)
F-Ratio:						
All Variables	6.16**		9.40**		3.63**	
Curriculum	2.34*		3.30**		1.88*	
Labor Market	2.34*		8.75**		0.73	
Marital Status	4.56**		2.90**		13.74**	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
# Adjusted for degrees of freedom.

TABLE XV

AVERAGE BEFORE TAX MONTHLY EARNINGS OF VOCATIONAL-TECHNICAL MALE GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After End of Schooling		Sixth Year After End of Schooling	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial@						
Food Service	80	(91)	-94	(99)	128	(108)
Building Trades Occupations	52	(93)	10	(100)	47	(109)
Mechanical and Repair	44	(52)	-37	(56)	92	(61)
Tool Design	109*	(54)	129*	(59)	102*	(64)
Wood Working Occupations	57	(66)	-21	(71)	70	(77)
Electrical and Electronics	27	(53)	10	(58)	25	(62)
Agriculture and Horticulture	190	(121)	123	(131)	210	(143)
Professional Occupations	46	(50)	-13	(54)	100	(59)
Clothing and Fabrics	269	(168)	-15	(182)	380*	(198)
Labor Market						
City A@						
City B	-21	(35)	28	(38)	-38	(41)
City C	14	(39)	-77	(42)	80*	(45)
IQ	1.42	(1.48)	2.10	(1.60)	1.58	(1.74)
White	114**	(44)	128**	(47)	87	(51)
Marital Status						
Married@						
Single	-108**	(34)	-41	(37)	-119**	(40)
Separated, Widowed, Divorced†						
Father's Education	2.32	(5.55)	-1.84	(6.02)	-0.91	(6.54)
Number of Observations	137		137		137	
Coefficient of Determination#	0.21		0.22		0.21	
Intercept	167	(169)	28	(183)	270	(198)
Standard Error of Estimate	158		172		186	
Mean of Dependent Variable	453	(168)	326	(183)	549	(198)
F-Ratio:						
All Variables	2.20*		2.27*		2.19*	
Courses	0.90		1.64		0.99	
Labor Market	0.37		2.83**		2.93**	

Notes:
- * Significant at the .05 level.
- ** Significant at the .01 level.
- b is the partial regression coefficient.
- (s) is the standard error of the partial regression coefficient.
- @ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
- † There are no observations for this regressor.
- # Adjust for degrees of freedom.

TABLE XVI

PERCENT OF TIME EMPLOYED OF VOCATIONAL-TECHNICAL MALE GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After End of Schooling		Sixth Year After End of Schooling	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial@						
Food Service	6.2	(7.4)	-21.8	(14.0)	2.6	(6.9)
Building Trades Occupations	9.6	(7.5)	12.8	(14.2)	2.8	(7.0)
Mechanical and Repair	0.7	(4.2)	-10.2	(8.0)	1.0	(4.0)
Tool Design	1.2	(4.4)	-0.8	(8.3)	1.4	(4.1)
Wood Working Occupations	2.0	(5.4)	-9.3	(10.1)	-1.0	(5.0)
Electrical and Electronics	-2.2	(4.3)	-9.1	(8.2)	-4.1	(4.0)
Agriculture and Horticulture	1.7	(9.9)	-18.8	(18.6)	1.5	(9.2)
Professional Occupations	-1.3	(4.1)	-7.0	(7.7)	-1.6	(3.8)
Clothing and Fabrics	7.3	(13.7)	19.9	(25.8)	-1.9	(12.7)
Labor Market						
City A@						
City B	-3.4	(2.8)	3.2	(5.4)	-2.9	(2.7)
City C	-4.8	(3.1)	-12.8	(5.9)	-3.3	(2.9)
IQ	0.05	(0.12)	0.50	(0.22)	-0.11	(0.11)
White	2.8	(3.5)	10.4	(6.7)	-0.4	(3.3)
Marital Status						
Married@						
Single	-3.8	(2.8)	-3.1	(5.3)	-4.4	(2.6)
Separated, Widowed, Divorced†						
Father's Education	-6.89	(0.45)	-2.40	(0.85)	-0.05	(0.42)
Number of Observations	137		137		137	
Coefficient of Determination#	0.10		0.21		0.06	
Intercept	93.0	(13.7)	54.0	(25.9)	113.3	(12.8)
Standard Error of Estimate	12.9		24.3		12.0	
Mean of Dependent Variable	93.0	(12.9)	84.4	(25.9)	97.7	(11.8)
F-Ratio:						
All Variables	0.98		2.18*		0.60	
Courses	0.48		0.95		0.39	
Labor Market	1.38		3.37		0.92	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
† There are no observations for this regressor.
# Adjust for degrees of freedom.

TABLE XVII

AVERAGE BEFORE TAX MONTHLY EARNINGS OF VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL FEMALE GRADUATES, CITIES A, B, AND C, IN DOLLARS

Variable	Average in Six Years		First Year After End of Schooling		Sixth Year After End of Schooling	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial[@]						
Food Service	-71	(49)	-68	(45)	-96	(67)
Tool Design	116	(129)	-77	(117)	274	(176)
Professional Occupations	7	(34)	-50	(31)	50	(47)
Distributive Education	-65	(58)	2	(53)	-97	(79)
Personal Services	-80**	(30)	-69**	(27)	-10	(41)
Clothing and Fabrics	-58	(42)	14	(38)	-102	(58)
Labor Market						
City A[@]						
City B	8	(16)	-21	(15)	26	(22)
City C	9	(15)	-26	(14)	44	(21)
IQ	0.71	(0.64)	0.70	(0.58)	-0.25	(0.88)
White	26	(20)	82**	(18)	-51	(27)
Marital Status						
Married[@]						
Single	96**	(15)	-1	(14)	190**	(21)
Separated, Widowed, Divorced†						
Father's Education	3.24	(2.26)	2.88	(2.05)	7.64*	(3.09)
Number of Observations	428		428		428	
Coefficient of Determination#	0.13		0.10		0.22	
Intercept	118	(68)	101	(62)	180	(93)
Standard Error of Estimate	128		116		175	
Mean of Dependent Variable	264	(136)	250	(121)	243	(195)
F-Ratio:						
All Variables	5.59**		4.20**		9.87**	
Courses	2.19*		2.20*		1.42	
Labor Market	0.19		2.00*		2.27*	

Notes:

*	Significant at the .05 level.
**	Significant at the .01 level.
b	is the partial regression coefficient.
(s)	is the standard error of the partial regression coefficient.
@	This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
†	There are no observations for this regressor.
#	Adjust for degrees of freedom.

TABLE XVIII

PERCENT OF TIME EMPLOYED OF VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOL FEMALE GRADUATES, CITIES A, B, AND C, IN PERCENTAGE POINTS

Variable	Average in Six Years		First Year After End of Schooling		Sixth Year After End of Schooling	
	b	(s)	b	(s)	b	(s)
Courses						
Commercial@						
Food Service	-11.2	(9.7)	-10.90	(10.3)	-12.0	(16.0)
Tool Design	4.8	(25.5)	4.3	(26.9)	10.9	(42.0)
Professional Occupations	-3.9	(6.8)	-3.1	(7.2)	8.5	(11.2)
Distributive Education	-6.8	(11.5)	17.5	(12.1)	-24.4	(18.9)
Personal Services	-10.0	(6.0)	-4.2	(6.3)	1.7	(9.8)
Clothing and Fabrics	-8.9	(8.4)	8.0	(8.9)	-23.9	(13.8)
Labor Market						
City A@						
City B	-1.8	(3.2)	-5.0	(3.4)	4.4	(5.3)
City C	-6.5*	(3.0)	-14.8**	(3.2)	1.8	(5.0)
IQ	-0.04	(0.12)	-0.10	(0.13)	-0.26	(0.21)
White	5.4	(4.0)	24.0**	(4.2)	-14.7*	(6.5)
Marital Status						
Married@						
Single	21.5**	(3.0)	-5.0	(3.2)	45.0**	(5.0)
Separated, Widowed, Divorced†						
Father's Education	0.86*	(0.44)	0.60	(0.47)	1.18	(0.73)
Number of Observations	428		428		428	
Coefficient of Determination#	0.14		0.14		0.20	
Intercept	66.1*	(13.5)	54.0**	(14.3)	80.3**	(22.2)
Standard Error of Estimate	25.3		26.7		41.58	
Mean of Dependent Variable	75.5	(26.9)	82.9	(28.5)	62.59	(46.1)
F-Ratio:						
All Variables	5.84**		6.09**		9.17*	
Courses	0.90		0.81		0.57	
Labor Market	2.43**		11.09**		0.35	

Notes:

* Significant at the .05 level.
** Significant at the .01 level.
b is the partial regression coefficient.
(s) is the standard error of the partial regression coefficient.
@ This regressor of the variable enters into the intercept term. The other regressors of the variable are interpreted as deviations from this regressor.
† There are no observations for this regressor.
# Adjust for degrees of freedom.

TABLE XIX

AVERAGE MONTHLY BEFORE TAX EARNINGS THE SIX-YEAR PERIOD AFTER GRADUATION, FOR GRADUATES OF THE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS VIS-A-VIS COMPREHENSIVE SENIOR HIGH SCHOOLS, SPECIALIZED SKILLS, CITIES A, B, AND C, IN DOLLARS[1]

Specialized Skill[2]	Curriculum					
	Vocational-Academic	Vocational-Technical				
	b (s)	b (s)	I (s)	SEE	F	$\bar{R}^2$
Commercial N = 536	42 (26)	14 (10)	120 (54)	111	1.74	.10**
Food Services N = 18	171 (105)	-104 (69)	392 (257)	88	3.04	.01*
Mechanical Repair N = 47	-	-45 (54)	-170 (258)	146	-	.08
Tool Design N = 40	-116 (206)	-21 (68)	578 (412)	182	0.19	.01
Electrical and Electronics N = 36	-	88 (62)	-272 (354)	167	-	.03
Professional, Semi-Professional, and Semi-Skilled N = 64	-	17 (28)	-84 (152)	106	-	.44**
Distributive Education and Selling N = 59	-202 (113)	-101* (43)	-69 (192)	150	4.10*	.38**
Personal Service N = 42	-9 (136)	40 (43)	22 (174)	120	0.43	.31**
Other N = 61	-70 (63)	22 (36)	247 (168)	123	0.92	.23**

TABLE XIX--Continued

[1] These specialized skill classifications are made on the basis of that job which was held longest during the sixth year after graduation.

[2] The specialized skills are classified according to the following general categories:

1) Commercial-Business Occupations: Data Processing, Stenography, Typing and Clerical.
2) Food Service Occupations: Restaurant Practice, Food Merchandising, Home Economics-Vocational, Baking.
3) Mechanical and Repair Occupations: Airframe and Power Plant Mechanics, Automotive Maintenance, Air Conditioning, Heat and Refrigeration, Welding, Gas and Electric.
4) Tool Design Occupations: Foundry Practice, Machine Construction, Machine Design and Drafting.
5) Electrical and Electronic Occupations: Instrumentation, Electronics, Electricity-Industrial, Radio and Television.
6) Professional and Semi-Professional Skilled and Semi-skilled Occupations: Music, Dental Assistant, Chemistry-Industrial, Art-Commercial, Textiles, Metallurgy, Architectural Drafting, Printing, Optical Mechanics, Shoe Repair.
7) Distributive Education and Selling Occupations.
8) Personal Service Occupations: Beauty Culture, Practical Nursing, Child Care, Dry Cleaning.
9) Other: All else.

Notes:

*	significant at the .05 level of significance.
**	significant at the .01 level of significance.
N	is the number of observations.
b	is the partial regression coefficient.
(s)	is the standard error.
I	is the intercept.
SEE	is the standard error of the estimate.
$\underline{F}$	is the F-ratio of the curriculum variable.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

TABLE XX

AVERAGE MONTHLY BEFORE TAX EARNINGS THE FIRST YEAR AFTER GRADUATION FOR GRADUATES OF THE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS VIS-A-VIS COMPREHENSIVE SENIOR HIGH SCHOOLS, SPECIALIZED SKILLS, CITIES A, B, AND C, IN DOLLARS[1]

Specialized Skill[2]	Curriculum					
	Vocational-Academic	Vocational-Technical				
	b (s)	b (s)	I (s)	SEE	F	$\bar{R}^2$
Commercial N = 536	-14 (28)	18 (12)	106 (58)	119	1.60	.09**
Food Services N = 18	234 (126)	-114 (82)	508 (308)	106	3.24	.01**
Mechanical Repair N = 47	-	-20 (74)	-284 (352)	200	-	.04
Tool Design N = 40	-186 (180)	21 (60)	662 (360)	159	0.64	.04
Electrical and Electronics N = 36	-	129 (68)	376 (390)	184	-	.01
Professional, Semi-Professional, and Semi-Skilled N = 64	-	8 (40)	-64 (212)	147	-	.17
Distributive Education and Selling N = 59	-116 (121)	-81 (46)	72 (206)	161	1.88	.09
Personal Service N = 42	83 (124)	114** (39)	-70 (159)	110	4.39*	.28*
Other N = 61	10 (67)	-6 (38)	-152 (178)	131	0.02	.34**

TABLE XX--Continued

[1] These specialized skill classifications are made on the basis of that job which was held longest during the sixth year after graduation.

[2] The specialized skills are classified according to the following general categories:

1) Commercial-Business Occupations: Data Processing, Stenography, Typing and Clerical.

2) Food Service Occupations: Restaurant Practice, Food Merchandising, Home Economics-Vocational, Baking.

3) Mechanical and Repair Occupations: Airframe and Power Plant Mechanics, Automotive Maintenance, Air Conditioning, Heat and Refrigeration, Welding, Gas and Electric.

4) Tool Design Occupations: Foundry Practice, Machine Construction, Machine Design and Drafting.

5) Electrical and Electronic Occupations: Instrumentation, Electronics, Electricity-Industrial, Radio and Television.

6) Professional and Semi-Professional Skilled and Semi-Skilled Occupations: Music, Dental Assistant, Chemistry-Industrial, Art-Commercial, Textiles, Metallurgy, Architectural Drafting, Printing, Optical Mechanics, Shoe Repair.

7) Distributive Education and Selling Occupations.

8) Personal Service Occupations: Beauty Culture, Practical Nursing, Child Care, Dry Cleaning.

9) Other: All else.

Notes:

*	significant at the .05 level of significance.
**	significant at the .01 level of significance.
N	is the number of observations.
b	is the partial regression coefficient.
(s)	is the standard error.
I	is the intercept.
SEE	is the standard error of the estimate.
F	is the F-ratio of the curriculum variable.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

TABLE XXI

AVERAGE MONTHLY BEFORE TAX EARNINGS THE SIXTH YEAR AFTER GRADUATION FOR GRADUATES OF THE VOCATIONAL-TECHNICAL SENIOR HIGH SCHOOLS VIS-A-VIS COMPREHENSIVE SENIOR HIGH SCHOOLS, SPECIALIZED SKILLS, CITIES A, B, AND C, IN DOLLARS[1]

Specialized Skill[2]	Curriculum					
	Vocational-Academic	Vocational-Technical				
	b (s)	b (s)	I (s)	SEE	F	$\bar{R}^2$
Commercial N = 536	40 (32)	18 (14)	161 (68)	141	1.20	.17**
Food Services N = 18	151 (172)	-2 (112)	-172 (423)	144	0.40	.01*
Mechanical Repair N = 47	-	-50 (50)	45 (243)	140	-	.09*
Tool Design N = 40	-150 (236)	-36 (78)	153 (473)	209	0.28	.09
Electrical and Electronics N = 36	-	42 (68)	-263 (384)	180	-	.09
Professional, Semi-Professional, and Semi-Skilled N = 64	-	24 (34)	-18 (181)	126	-	.43**
Distributive Education and Selling N = 59	-219 (163)	-135* (62)	20 (278)	216	3.04	.27**
Personal Service N = 42	-52 (206)	66 (64)	51 (262)	182	0.58	.30**
Other N = 61	-169* (75)	34 (43)	296 (200)	147	3.23*	.29**

TABLE XXI--Continued

[1] These specialized skill classifications are made on the basis of that job which was held longest during the sixth year after graduation.

[2] The specialized skills are classified according to the following general categories:

1) Commercial-Business Occupations: Data Processing, Stenography, Typing and Clerical.

2) Food Service Occupations: Restaurant Practice, Food Merchandising, Home Economics-Vocational, Baking.

3) Mechanical and Repair Occupations: Airframe and Power Plant Mechanics, Automotive Maintenance, Air Conditioning, Heat and Refrigeration, Welding, Gas and Electric.

4) Tool Design Occupations: Foundry Practice, Machine Construction, Machine Design and Drafting.

5) Electrical and Electronic Occupations: Instrumentation, Electronics, Electricity-Industrial, Radio and Television.

6) Professional and Semi-Professional Skilled and Semi-skilled Occupations: Music, Dental Assistant, Chemistry-Industrial, Art-Commercial, Textiles, Metallurgy, Architectural Drafting, Printing, Optical Mechanics, Shoe Repair.

7) Distributive Education and Selling Occupations.

8) Personal Service Occupations: Beauty Culture, Practical Nursing, Child Care, Dry Cleaning.

9) Other: All else

Notes:

*	significant at the .05 level of significance.
**	significant at the .01 level of significance.
N	is the number of observations.
b	is the partial regression coefficient.
(s)	is the standard error.
I	is the intercept.
SEE	is the standard error of the estimate.
F	is the F-ratio of the curriculum variable.
$\bar{R}^2$	is the coefficient of determination adjusted for degrees of freedom.

APPENDIX VI

DEFINITIONS OF SENIOR AND VOCATIONAL-TECHNICAL HIGH SCHOOL CURRICULA

For the purpose of this study, the curricula of the graduating student body for each city are broken into five classifications. These are: 1) academic or college preparatory; 2) vocational-technical; 3) vocational-academic; 4) comprehensive-vocational; and, 5) general. The criteria for distinguishing between these five types of curricula are as follows:

1) Academic or College Preparatory

The major characteristics of this curriculum are as follows:

a) A total of 2 or more units in mathematics, such as algebra, trigonometry, geometry or advanced algebra. A general mathematics or general arithmetic course does not count.

AND

b) A total of 2 or more units in science, such as chemistry, physics, biology, organic chemistry or qualitative analysis. The survey-type science course does not count.

AND

c) A total of 2 or more units in any given foreign language.

AND

d) If industrial education courses are taken, less than three units of credit in any given skill area.

All four of these criteria must be fulfilled for the graduate to qualify for the academic curriculum.

2) Vocational-Technical

The major characteristics of this curriculum are as follows:

a) A total of 3 or more units of credit are taken in some recognized skill area of industrial education.

OR

b) One or more units of stenography or shorthand are taken.

AND FINALLY,

c) Less than 2 years of foreign language is taken.

OR

d) Any person, male or female, taking the equivalent of a four semester sequence (two units) in distributive education qualifies as vocational-technical.

The basic distinction is that a student must have concentrated his efforts in a coherent area of vocational or technical study. A mixture of courses in business education, distributive education, or home economics, adding up to three units of credit does not qualify a person as a vocational-technical graduate.

3) Vocational-Academic

This curriculum will have the following characteristics:

a) A total of 2 or more units of a foreign language

AND,

b) A total of 2 or more units of mathematics, exclusive of general arithmetic or general mathematics

c) A total of 2 or more units of science credit, which excludes a general survey course in science

AND,

d) A total of 3 or more units of credit for a given skill in the industrial education course area.

OR,

e) One or more units of shorthand or stenography.

OR,

f) The four semester sequence (two units) in distributive education.

In short, the student has a dual qualification both as academic or college preparatory and vocational-technical.

4) Comprehensive-Vocational

The characteristics of this curriculum are as follows:

a) Less than 2 units of foreign language.

AND,

b) Only the minimum requirements will be met for mathematics and science.

AND,

c) More than one unit but less than three units of credit may be taken in any given industrial education skill specialty.

OR,

Some shorthand or stenography, but less than one unit can be taken.

OR,

For distributive education areas, more than one, but less than two units of credit can be taken.

Finally, relative to the general curriculum, the student in the vocational-comprehensive curriculum will have a tendency to take a greater number of vocationally oriented courses, regardless of their type.

5) General

Broadly speaking, the general curriculum is an academic curriculum below the level of college preparatory. The following are major distinctions.

(a) Less than 2 units of foreign language are taken.

AND,

(b) Less than two units of science are taken, exclusive of general science.

AND,

(c) Less than two units of mathematics are taken. The mathematics which is taken will usually be general arithmetic or general mathematics.

AND,

(d) Only one unit of credit or less is taken in any given industrial education, business education, distributive education or home economics skill specialty.

OR,

Less than one unit of stenography may be taken.

A lack of specificity, direction or career orientation characterizes this course of study. There will be a tendency to concentrate more heavily in the business, distributive, and home economics education areas relative to the industrial education area of study.

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